Journal

of the

Royal Army Medical Corps

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EDITED BY

COLONEL SIR WILLIAM H. HORROCKS, K.C.M.G., C.B.

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COLONEL D. HARVEY, C.M.G., C.B.E., R.A.M.C.

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Original Communications.

NOTES ON BLACKWATER FEVER IN MACEDONIA.

BY COLONEL A. G. PHEAR, C.B.
Army Medical Service.
Consulting Physician to the British Salonika Force.

DURING the year ending October 31, 1918, 136 cases of blackwater fever were reported among the British troops in the Salonika Command. Of these cases thirty-six died, giving a case mortality of 26·5 per cent.

SEASONAL INCIDENCE.

Reference to the accompanying chart shows that 116 out of the total of 136 cases were reported during the months December to April inclusive, and that the case incidence reached its maximum during February, in which month 32 cases were reported. During the summer months from June onward no case of blackwater fever occurred until September, in which month nine cases were reported. The cause of this striking and unexpected recrudescence in late summer is not clear, but in point of time it was clearly associated with a period of exceptional fighting activity, the outbreak being limited to the three weeks immediately preceding the enemy capitulation. In the following month (October) only a single case was reported.

In the course of the winter (1917-18) there were three short spells of exceptionally rigorous weather. The first of these was in early December and coincided with the onset of the blackwater fever "season." The season was in the beginning of January and was followed by no material increase in the number of cases reported. The third was at the end of March, when a blizzard of exceptional severity was perhaps responsible for the check in the rapid fall of the blackwater fever curve which had already set in.

It is of interest to note that, though the admissions from blackwater fever were considerably higher during February than in any other month of the year, there was no specially severe weather either in that month or in the latter half of the previous one. While the general rule holds good that blackwater fever is limited almost exclusively to the cooler months of the year, it would seem that temporary weather vicissitudes have but little effect on the incidence of the disease.

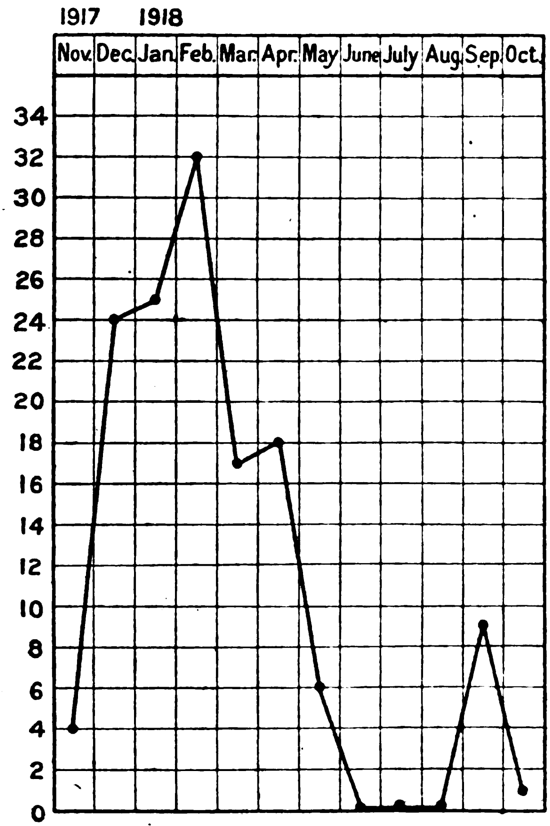


CHART 1.—Showing number of cases reported monthly.

Nearly eight times as many cases of blackwater fever were recorded during the year under review as in the previous year. The actual figures are 136 for the season 1917-18, as compared with eighteen for 1916-17. The reason for this striking difference is not clear. It has been suggested that the tendency to blackwater is greater in those who are in their second season of malaria; but this is not sufficient explanation, as out of forty-seven cases in which precise information is available, in only ten did the first attack of malaria date back to twelve months or more before the

onset of blackwater; in twenty-four cases (roughly fifty per cent) the first attack of malaria fell within six months of the occurrence of blackwater fever.

Relation to Malaria.

In the ætiology of blackwater fever the outstanding feature is the constant association of malaria as an antecedent condition. In only one out of a series of seventy-eight cases was a history of malaria not forthcoming, and in view of the special prevalence of malaria in the command it may fairly be assumed that this solitary case was no more than an apparent exception to the rule. But apart from this general relationship, there has been found in the majority of cases no evidence of active malaria accompanying the actual attack of blackwater. Of fifty-eight cases in which careful search was made in sixteen only (twenty-seven per cent) were parasites found in the peripheral blood during the attack, and in nearly all of these the degree of infection as judged by the number of parasites present was a very slight one. Of these 16 positive cases 7 were examples of benign tertian, 4 of malignant tertian malaria, while in 5 the parasites were described as being of indeterminate type. In six cases in which repeated search for parasites was made during the actual attacks with consistently negative results, positive films had been obtained shortly before the attack at intervals varying from two to ten days. In one case there were two paroxysms of blackwater at four weeks' interval; in neither of the attacks were parasites found, but benign tertian rings in small numbers were present on one occasion during the interval.

These observations are in conformity with the view that some factor other than a direct malarial infection is effective in determining the actual explosion which constitutes the attack of blackwater fever—a view which gains further support from the consideration that the incidence of blackwater fever is at its height during the period of the year at which malarial activity is at its lowest ebb. The opposite would presumably be the case if blackwater fever were no more than a special manifestation of malaria.

Quinine and Blackwater Fever.

The experience of the past season has supplied no evidence in support of the hypothesis that the determining cause of an attack of blackwater is to be found in quinine administration. On the contrary, the facts are opposed to this hypothesis. Included in the series is a number of cases in which quinine as an exciting cause can be definitely excluded, as during a considerable period previous to the onset of blackwater no quinine had been given. On the other hand cases of severe blackwater fever occurred in which the condition cleared completely and rapidly notwithstanding the administration of quinine in large doses. With a few medical officers the view was favoured that blackwater was a symptom of a specially pernicious form of malaria, and acting on their convictions they were in the habit of

treating cases of blackwater fever with full doses of quinine. Apart from the question as to whether this was sound treatment, the cases thus treated have provided clear proof that the administration of large doses of quinine is no bar to the speedy and complete disappearance of hæmoglobin from the urine. These cases have at least done no worse than those in which quinine has been at once stopped with the onset of hæmoglobinuria. In the light of the above facts it is impossible to regard quinine as a direct causal agent in the production of blackwater fever, or even as a subsidiary factor in maintaining or adding to an effect which is directly due to some other agent. This conclusion is not invalidated by the well-known fact that certain individuals, not necessarily the subjects of malaria, are peculiarly susceptible to the effects of quinine, and that small quantities of the drug may in these cases lead to hæmolysis, with the production of hæmoglobinuria. An instance of the kind was met in the case of a Greek boy, who had had malaria, and in whom a dose of quinine was followed by hæmoglobinuria with the development of an intense grade of anæmia. It was thought the matter might be a coincidence, and accordingly, as there were special reasons for quinine treatment, a further small dose of ten grains was given after an interval of a week or two, but with the same dramatic effect of an intense hæmolysis with severe anæmia. Examples of such idiosyncrasy are fortunately very rare.

Clinical Features.

From the clinical point of view the cases observed during the past season have presented no exceptional features. The sudden hæmolysis of catastrophic severity, with a corresponding drop in the number of red corpuscles to thirty per cent or even twenty per cent of the normal number, the state of collapse with extreme pallor and small compressible pulse, the dark coloured urine with characteristic spectroscopic phenomena, rapidly clearing in the course of a few days, the pyrexia of sudden onset with headache, shivering and pains in the loins all go to form a disease picture which in the cases under review differs in no essential respect from other epidemics.

The average time during which hæmoglobin was present in the urine was three days. The longest period was five days; the shortest was in the case of a patient who on one occasion only passed dark red urine showing characteristic absorption bands; all subsequent specimens were clear. Recurrences were uncommon; in 6 cases only of a total of 78 (8 per cent) was there a definite relapse of blackwater. In four of these cases the second attack was relatively mild; the other two were fatal. In one case of blackwater lasting for five days there were two occasions on which perfectly clear urine free from blood was passed; subsequent urine was deeply coloured with blood.

In almost every case there was enlargement and tenderness of the liver.

This was in many instances associated with vomiting and jaundice. The degree of jaundice varied from a slight icteric tinge to a deep coloration of the skin, and afforded a fairly reliable indication of the seriousness of the case. Of 30 fatal cases, in 13 there was well-marked jaundice, and in 17 the generalized icteric staining of the skin was intense.

Suppression of urine was an almost constant feature of the fatal cases. In 18 of 30 fatal cases the suppression was complete and of the remainder in all except 2 the excretion of urine was reduced to a few ounces per diem. In only two of the fatal cases was a fair excretion of urine maintained; in one of these death was due to cardiac failure, on the fifth day after the urine had become completely clear from hæmoglobin; in both the heart was found post mortem to be considerably dilated with pale and flabby muscle. The conclusion was justified that so long as urine is being freely passed the risk of a fatal event is almost negligible.

Repeated vomiting and uncontrollable hiccough were common symptoms in the cases with suppression of urine, but other manifestations of acute uræmia were not observed. In a few cases the symptoms resembled those of a calculous anuria, the patient remaining for several days with urinary suppression, but, until a few hours from the end, with symptoms so slight as to convey no indication of the extreme gravity of the condition.

The volume of urine secreted during the blackwater phase in non-fatal cases without suppression was very variable. Careful measurements were made in a series of twenty-five cases. In 9 cases the daily average quantity passed during the period of blackwater was higher than 60 ounces with a maximum of 85 ounces; in 16 cases the daily average was below 60 ounces with a minimum of 20 ounces. The average of the whole series was fifty-three ounces. When the large quantity of fluid which was being administered and absorbed in all these cases is considered, the somewhat excessive amount of urine secreted in a few instances is readily accounted for and there is no ground for assuming that hæmoglobin in its passage through the kidney had any specific action as a diuretic. In a few cases the presence of hæmoglobin in solution in the blood plasma was demonstrated. No extended observations were made on this point.

The number of cases in which a series of leucocyte counts was made is small, but the evidence so far as it goes is not in favour of a marked leucocytosis as a common feature of blackwater fever. Of 9 cases, in 1 only were there more than 10,000 leucocytes to the cubic millimetre; in this case the highest leucocyte count was 10,600 on the fourth day of blackwater; of the remaining 8 cases the highest count ranged from 3,600 to 8,800.

Uninterrupted convalescence was the rule with a rapid formation of new blood-elements even in cases which initially were of great severity; it was a common experience to find that in the course of three weeks the number of red corpuscles had been more than doubled. No hæmoglobin observations are recorded here as it was found that the instruments had suffered from the climate and were not reliable.

TREATMENT.

The three essentials in the treatment of blackwater fever were found to be: (*a*) Rest: (*b*) protection against chill by suitable coverings, hot water bottles, etc.; (*c*) the introduction of large quantities of fluid into the system with the object of maintaining a free flow through the kidneys and thereby lessening the risk of suppression of urine. Whenever possible cases were treated in hutted hospitals; but in cases arising at a distance it was not considered justifiable to expose the patient to the risks involved in a journey to the base and such cases were treated at the nearest tented hospital or casualty clearing station. As far as practicable the requisite amount of fluid was given by mouth; but in cases of vomiting or when it was required to supplement the amount taken by mouth, the subcutaneous, rectal, or intravenous routes were utilized. The slow rate at which fluid is absorbed subcutaneously, or per rectum, rendered these channels preferable to the intravenous route. Rectal injections were usually given in quantities of fifteen to twenty ounces of normal saline at intervals of four or six hours. In a few cases by means of a Souttar's apparatus continuous rectal saline was administered up to five or six pints in the twenty-four hours with very satisfactory results; the fluid is absorbed as it flows into the rectum and the method is free from drawback other than the slight inconvenience caused by the presence of the rectal tube. Dry cupping over the loins appeared in some cases to be beneficial. For the treatment of vomiting and obstinate hiccough Sternberg's mixture containing sodium bicarbonate and perchloride of mercury was given in some cases, but without any marked degree of success. In a few instances these refractory symptoms were checked by hypodermic injections of hyoscin ($\frac{1}{100}$ grain) combined with morphia ($\frac{1}{6}$ grain).

The usual practice as regards quinine has been to withhold it in the absence of definite evidence of active malaria. The presence of parasites in the blood, or of tenderness over an enlarged spleen, have been taken as indications for quinine, which has then been given in effective doses until the malarial manifestations have been brought under control.

After the subsidence of acute symptoms a generous and varied diet has been found essential to the establishment of a satisfactory convalescence. Arsenical preparations are of great value in promoting blood formation. Arsenic has been given (*a*) by the mouth, either alone or in combination with iron; (*b*) subcutaneously in the form of sodium cacodylate; (*c*) intravenously in the form of galyl in doses of 0·2 or 0·3 gramme at intervals of four days; three doses are generally sufficient. In a few cases of extreme anæmia galyl has been used with remarkable benefit; in cases of anæmia of ordinary severity the subcutaneous and intravenous methods do not offer any special advantages over the method of oral administration except in cases where on account of gastric disturbance it is undesirable to push arsenic by the mouth. All convalescent cases were evacuated by hospital ship as soon as a convenient opportunity arose.

In illustration of the above remarks charts and short notes of fifteen cases are appended. The amounts of quinine are stated in grains; O signifies oral, IM intramuscular quinine. In estimating the percentage of red blood corpuscles, 5,000,000 is taken as the normal standard. In most cases the presence of hæmoglobin in the urine was proved by spectroscopic examination; in some units no spectroscope was available, and microscopic examination was relied on for differentiating between hæmoglobinuria and hæmaturia.

No. 67.—Aged 36. First attack of malaria in August, 1917; many relapses since; in hospital six times. Quinine, none for seven weeks prior to admission. Taken ill on February 13 with shivering, headache and vomiting. Slight jaundice, deepening later. Spleen large. Benign tertian parasites present at onset. (Chart 2.)

Note.—No quinine previous to blackwater. Rapid improvement while taking quinine.

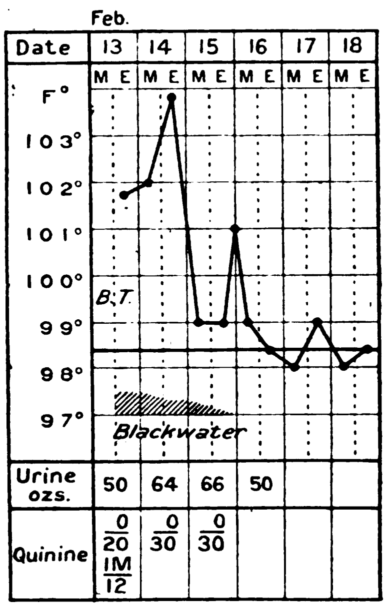


CHART 2.

No. 52.—Aged 38. History of one attack of malaria only, in July 1917. No quinine since December. Noticed urine was "quite dark" on March 6 and 7; admitted on following day. On March 12 benign tertian parasites found in blood; previous films had been negative. (Chart 3.)

Note.—No quinine since December. No recurrence of blackwater during quinine treatment.

No. 22.—Aged 27. Five attacks of malaria, the last December 14, 1917. Very pale and ill on admission, with marked jaundice. Spleen and liver enlarged and tender. No parasites found. (Chart 4.)

Note.—Rapid clearing of blackwater during administration of considerable doses of quinine.

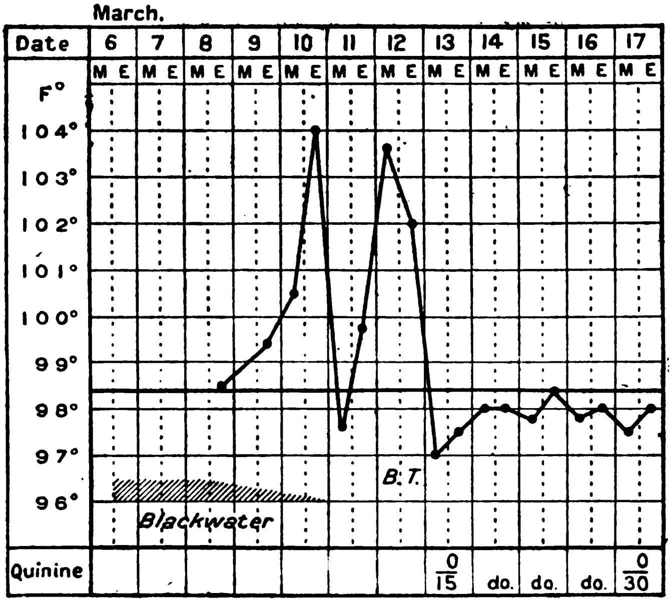


CHART 3

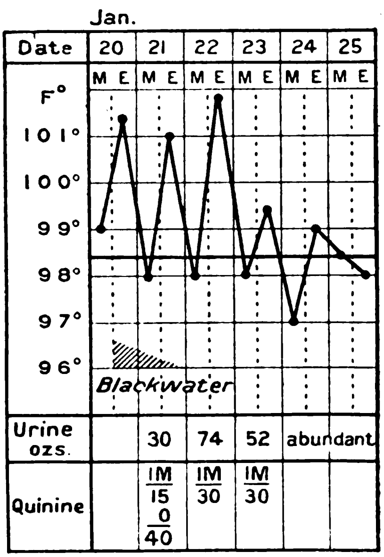


CHART 4.

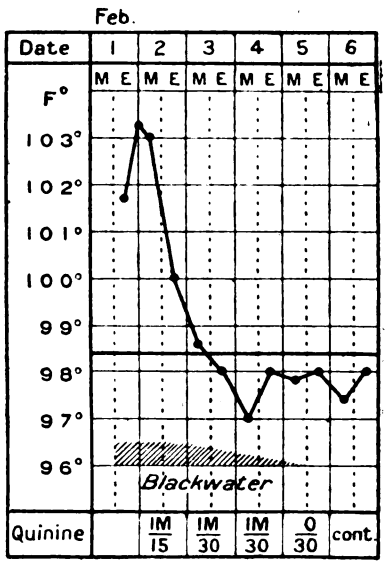


CHART 5.

No. 36.—Aged 25. Malaria, "two or three attacks." Spleen large and tender. Liver tender. Marked jaundice. (Chart 5.)

Note.—Satisfactory clearing of urine during quinine administration.

No. 42.—Aged 24. Malaria, eight attacks, date of first not stated. Admitted to base hospital on February 1, 1918, passing urine like blood, free in amount. Characteristic absorption bands. No parasites found in blood. (Chart 6.)

Note.—Clearing of blackwater while taking quinine. Rapid formation of new blood-elements.

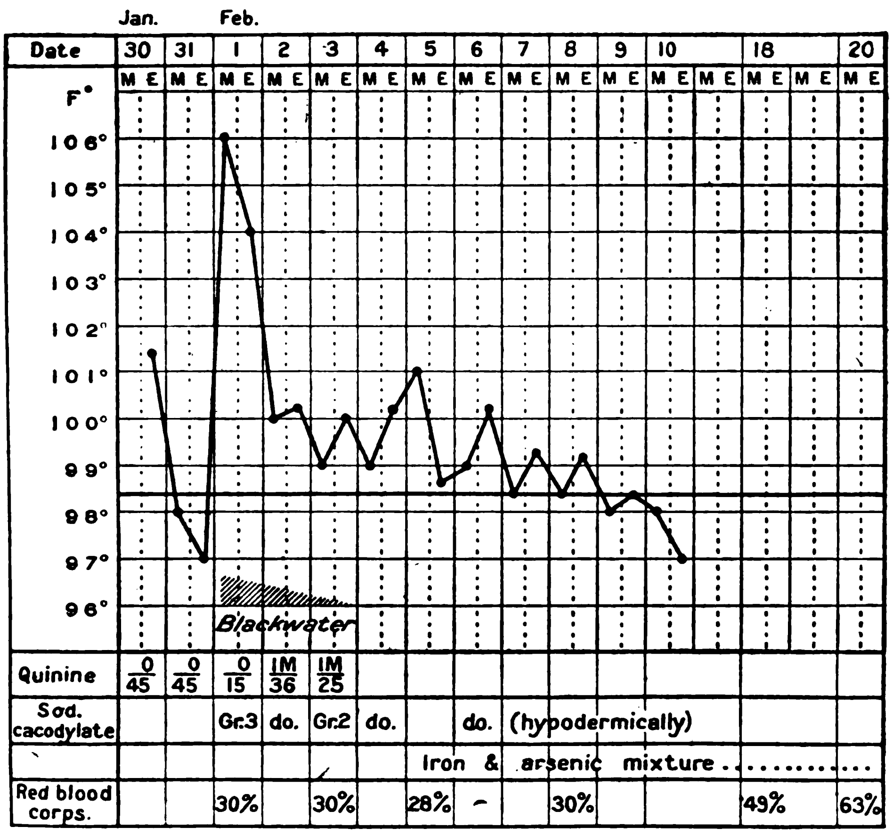


CHART 6.

No. 60. Aged 25. First attack of malaria July, 1917; twelve relapses. On admission vomiting, deep jaundice, spleen large and tender, benign tertian parasites in blood, urine dark brown with characteristic absorption bands. (Chart 7.)

Note.—Rapid clearing of urine while under quinine treatment.

No. 68.—Malaria first attack September, 1917, frequent relapses. On March 19, 1918, a malarial relapse; quinine thirty grains given this day and subsequently. An attack of blackwater five days later clears during continuance of quinine. (Chart 8.)

Note.—Blackwater runs its course apparently uninfluenced by quinine.

No. 29.—Aged 33. First attack of malaria June, 1916, two attacks since. Admitted for malarial relapse in December, 1917. (Chart 9.)

Note.—An attack of blackwater fever a few days subsequent to a relapse of malaria (clinical). Quinine was stopped with the onset of blackwater.

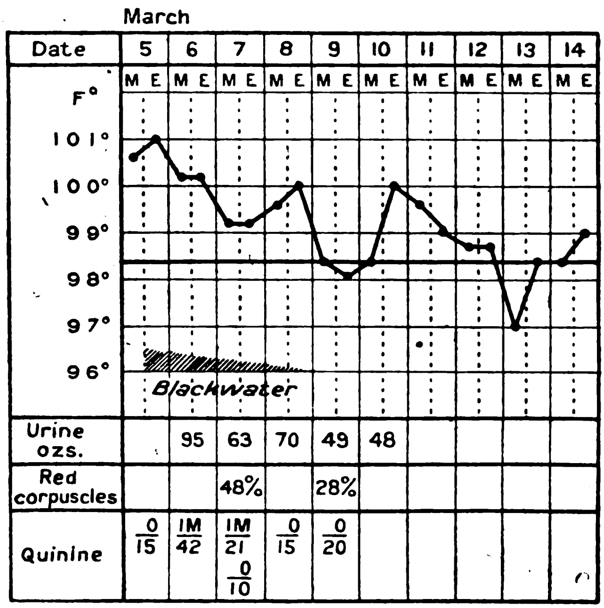


CHART 7.

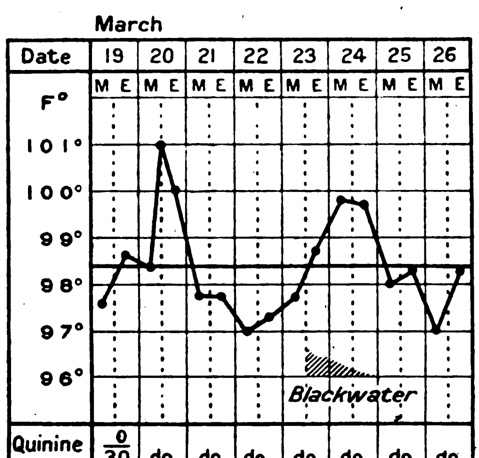


CHART 8.

No. 57.—Aged 21. No notes as to malarial history. Has had quinine in ten- or twenty-grain doses daily during last month. Was ill three days before admission with vomiting and shivering, but noticed that urine was dark for the

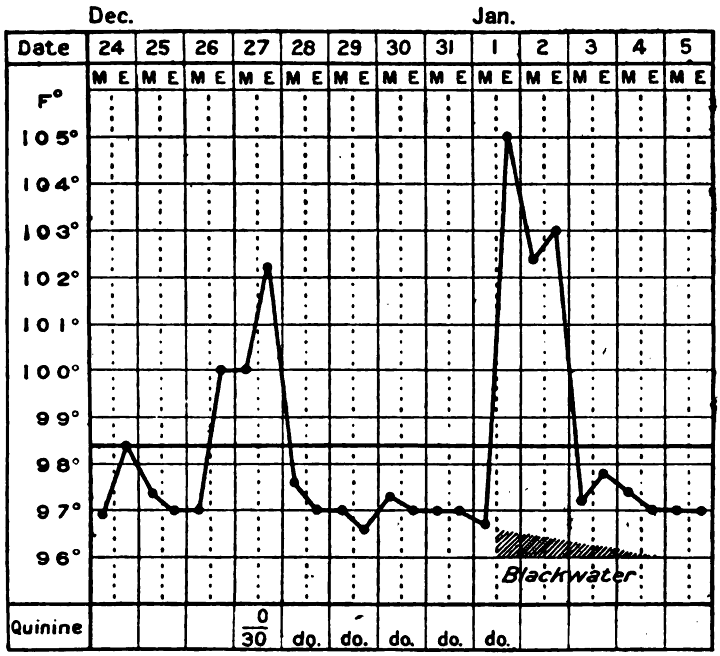


CHART 9.

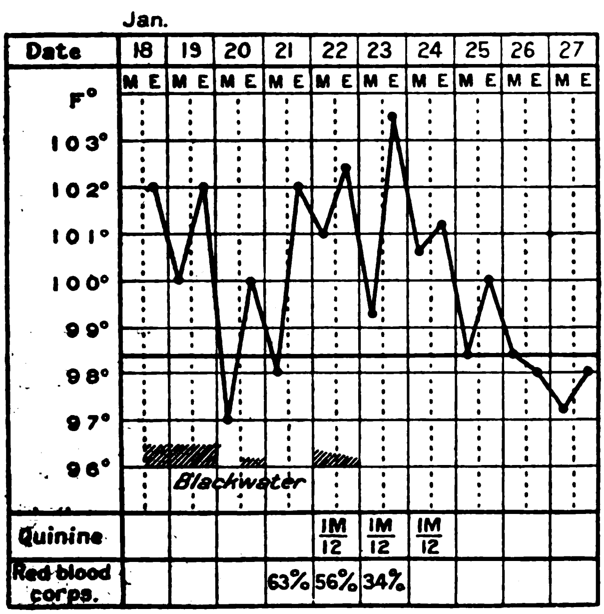


CHART 10.

first time on day of admission. Spleen and liver both enlarged and tender. Vomiting. Slight jaundice. No parasites found in blood on repeated examination. After two days of blackwater a perfectly clear sample of urine was passed containing no blood. This was followed by plentiful urine tinged red. Next day the urine was clear; on the following day a large amount of very dark hæmoglobin containing urine was passed. (Chart 10.)

Note.—Interruptions in course of blackwater; rapid fall in number of red corpuscles.

No. 25.—Aged 31. Twelve attacks of malaria. No quinine for six weeks previous to onset of blackwater. Noted that urine was dark a few hours before admission. Vomiting and jaundice, marked symptoms. Liver enlarged and tender. Spleen tender. No quinine given. Almost complete suppression of urine; becomes clear two days before death. (Chart 11.)

Note.—A fatal case in which no quinine had been taken for six weeks previous to attack. Urine clears two days before death.

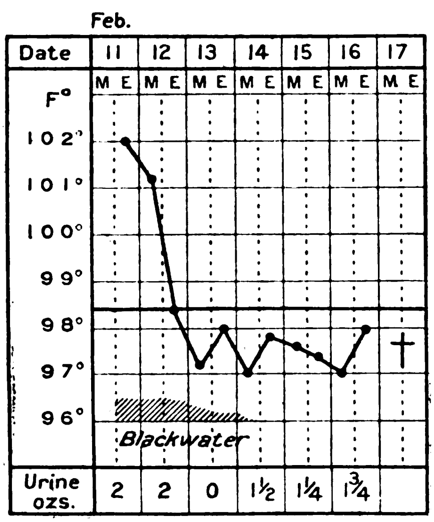


CHART 11.

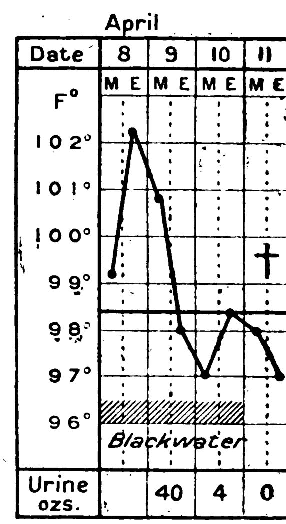


CHART 12.

No. 63.—Aged 41. Ill three days with "malaria"; no previous history. Jaundice on admission; becomes intense. Vomiting. Spleen to umbilicus. Blood-films negative. Suppression of urine. Death. (Chart 12.)

No. 46.—Aged 23. Admitted to casualty clearing station on November 24 with history that he was taken ill on November 22 with headache, shivering, vomiting, and passing urine coloured like blood. On admission temperature was 105·2° F.; he was very anæmic, with large tender spleen and tender liver. Frequent vomiting and severe hiccough. From date of admission to his death five days later (on November 29) no urine was passed with the exception of a few cubic centimetres on November 25, porter-coloured and showing characteristic absorption bands. Hiccough and vomiting ceased two days before death. Blood

films were negative on repeated examination. The temperature chart of this case is unfortunately missing.

Note.—Suppression of urine, practically complete, for five days previous to death.

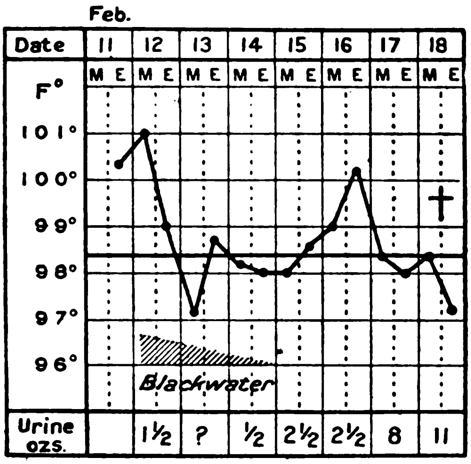


CHART 13.

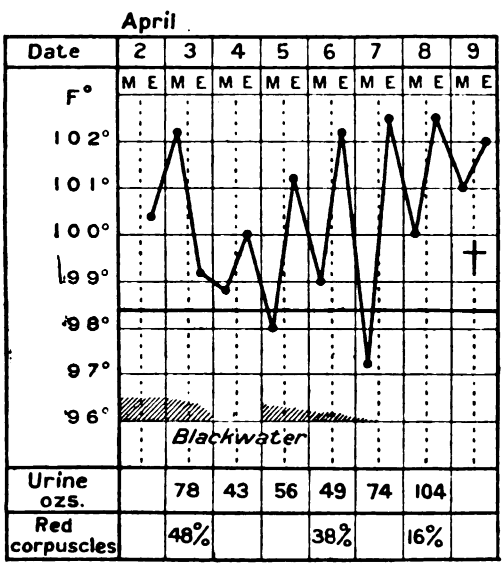


CHART 14.

No 40.—Aged 24. First attack of malaria July, 1917; two or more attacks since; malignant tertian parasites found in September, 1917. On February 11, 1918, shivered and was sick and passed no urine after 11 a.m. On following day passed 1½ ounces of porter-coloured urine giving characteristic spectroscope bands. Marked jaundice. Liver and spleen both enlarged and very tender.

Blood-film negative. On February 15 the urine was clear. Subsequently his general state rapidly became worse and he died on February 18, although the urine remained clear and had increased somewhat in quantity. (Chart 13.)

Note.—The clearing of urine and slight increase in quantity during the two or three days before death.

No. 62.—Aged 27. First attack of malaria July, 1917. Eleven relapses. Jaundice slight at onset; deepens and becomes intense with frequent vomiting and large tender liver. No parasites found. Death two days after urine had become clear. (Chart 14.)

Note.—Recurrence of blackwater; free secretion of urine to the end; rapid destruction of red corpuscles.

No. 18.—Aged 27. Malaria "frequent attacks." Death from cardiac failure on fifth day after urine had become clear. (Chart 15.)

Note.—Abundant urine secreted up to date of death.

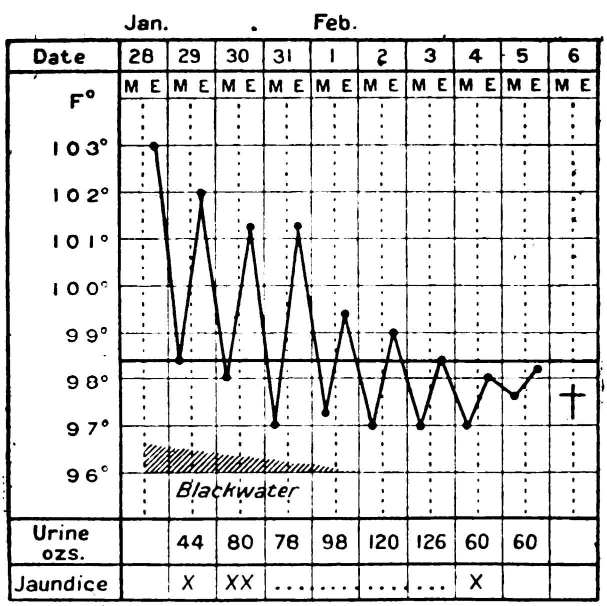


CHART 15.

In conclusion I wish to express my indebtedness to medical officers and officers in charge of divisions of hospitals, who by their careful observations made often under difficult circumstances have provided the data on which the above notes are based. I have to thank Lieutenant-Colonel J. A. Anderson, R.A.M.C., for the curve showing the seasonal incidence of the disease.

BILHARZIASIS AND MALARIA DURING THE PALESTINE CAMPAIGN.

By Major CHARLES SEARLE, M.C.
Royal Army Medical Corps.

Introduction.

Bilharziasis and malaria will be considered in this paper entirely from the standpoint of a regimental medical officer.

A special reference will be made to the anti-mosquito campaign carried out during the spring and summer of 1918, in the vicinity of the River Auja.

A regimental medical officer's primary duty is the prevention of disease in his battalion. Lieutenant-Colonel Lelean in his admirable book "Sanitation in War" describes him as the "final link in the chain, whose duties are not only concerned with the maintenance of health and prevention of sickness, but also involve the keeping of a watchful eye upon every factor which affects the comfort and well-being of his men."

These notes were written with the hope that they may be of some interest to other regimental medical officers, faced with the same problems in dealing with bilharziasis and malaria during a campaign. The medical officer "on trek" with his battalion, with a kit possibly limited to eighteen pounds, had little facility for accurate clinical diagnosis. He had no books of reference, and perhaps only a scanty knowledge of tropical medicine. He depended largely on his own commonsense to protect the men of his battalion against infection carried by the *Bullinus contortus* snail and the anopheles mosquito—the best allies the Turks ever had.

No attempts will, therefore, be made to discuss the clinical side of the treatment of these diseases. Nor shall I attempt to discuss the effect of bilharzia and malaria on the Palestine Campaign as a whole, but rather to relate my own personal experiences and observations, and to describe how my own men became infected, and what measures were taken to protect them when "in the line." These notes will therefore of necessity only cover a small portion of a very wide front, and chiefly concern the health of the 1/4 Northamptonshire Battalion, when they were stationed during 1916 in the Southern Sector of the Suez Canal defences; and when, subsequently, in 1918, they held a part of the line in the vicinity of the River Auja. I have combined bilharziasis with anti-mosquito work because we discovered infected *B. contortus* snails in an orange grove cistern near Mulebbis when searching, on February 10, 1918, for the presence of anopheline larvæ. Official information, it may be added, was to the effect that there was no bilharziasis in Palestine and that *B. contortus* was not found in this neighbourhood.

We had one great advantage in the spring of 1918, namely, personal

instructions from Colonel Fowler, Major E. Austen and Captain Bahr, to whom the medical officers of the East Anglian Division are much indebted for their advice and assistance in dealing with these two problems.

Personally I do not believe that the Auja line could have been held through the spring and summer of 1918 without the active anti-mosquito campaign organized by these specialists.

My thesis will be discussed under the following headings:—

I.—An Outbreak of Bilharziasis in Sinai among the Northamptons in 1916.

II.—The Discovery of Bilharziasis among the Orange Groves of Mulebbis in 1918.

III.—A localized Outbreak of Malignant Tertian Malaria at a Desert Post in Sinai in 1916.

IV.—Anti-mosquito Work in the vicinity of the River Auja during spring and summer of 1918.

I.—An Outbreak of Bilharziasis in Sinai among the Northamptons in 1916.

The outbreak of vesical bilharziasis among the 1/4 Northamptons involved one officer and twenty-one men. These cases all reported "sick" between the dates November 23, 1916, and April 25, 1917, after which there were no further cases.

Movements of the Battalion.

The battalion had been in Gallipoli in 1915, and had had no previous case of bilharziasis. They were then moved to Egypt. They moved from Shallufa to Kubri, a desert post in Sinai on the eastern bank of the canal, approximately eight miles north-east of Suez on May 20, 1916. The men were here in camp under canvas, until the spring of 1917, prior to their taking part in the march across the Sinai Peninsula. The men had had no previous opportunity of fresh-water bathing in Egypt.

Methods of Infection.

(*a*) *Sweet-water Canal.*—Nineteen of the twenty-two cases can be definitely traced to bathing and fishing in the Sweet-water Canal during the last week in May, 1916, just after the battalion had arrived at Kubri.

The Sweet-water Canal runs parallel to the Suez Canal on the western bank. It was easily accessible to the men in camp at Kubri who crossed the Suez Canal by the wooden bridge, and then had half a mile to walk to reach the Sweet-water. The Sweet-water Canal is swift flowing; native villages are built along its banks, and there are swamps in many places close by. The Sweet-water Canal was known to be infected with bilharziasis which is there endemic. *B. contortus* snails, the host of the vesical form of bilharziasis, are found practically universally in the

Sweet-water Canal and in the swamps; but *Planorbis boissyi*, which harbours the cercaria of the rectal form of bilharzia, and is easily distinguished by its ammonite appearance, was not found in the Sweet-water Canal near Kubri. Dr. Leiper of the London School of Tropical Medicine found *P. boissyi* in the swamps and marshes around Ismailia, but not near Suez. Both snails are common all over Lower Egypt, but in Dr. Leiper's opinion, *P. boissyi* is restricted to the irrigation channels and drains, while *B. contortus* occurs in these channels as well as in the large canals. When the Northamptonshire battalion first arrived at Kubri, men were warned, both on parade and in orders, of the danger of bathing in the Sweet-water, and this order was republished monthly in orders. Nevertheless nearly eighty men in the battalion bathed on at least one occasion in the Sweet-water Canal, and nineteen of these men subsequently developed vesical bilharziosis.

(*b*) The remaining three cases of bilharziasis can be traced to washing in a cattle trough at Kubri, the water of which was drawn from the Sweet-water Canal by pipes which passed beneath the Suez Canal to the Sinai bank, and so supplied the post at Kubri. This water was siphoned off from an area protected by barbed wire, and it was then pumped through a system of pipes under the Suez Canal. In June, 1916, there were two different systems of water supply. The supply of water for the cattle troughs did not pass through a filter bed, but was pumped into canvas troughs adjacent to the battalion football ground, and labelled "not drinking water." The drinking water, on the other hand, went through a filter bed reservoir.

On rejoining my unit from sick leave on June 3, 1916, I observed a man who had been playing football washing his face and hands in this cattle trough. This practice was at once stopped, and the matter reported. But three men, Ptes. D., J. and A., subsequently developed bilharziasis. They all stated that they had never bathed or washed in the Sweet-water Canal, but admitted they had washed in the cattle troughs at the Kubri Camp.

Incubation Period.

The first case of bilharziasis who reported at sick parade with hæmaturia was Lance-Cpl. J. on November 23, 1916, six months after infection. All the twenty-two cases were infected between the dates May 20, 1916, and June 6, 1916.

The longest period of incubation before any symptoms of hæmaturia started was Pte. A. (who washed in the cattle trough but had not bathed in the Sweet-water Canal) on June 3, 1916. Hæmaturia did not start until April, 1917. Pte. A., three hundred and twenty-six days after infection, on April 25, 1917, was the last case admitted to hospital.

The seven cases admitted to hospital at Mazar on March 7, 1917, were discovered by the courtesy of the Anzac field laboratory, who examined eleven officers and 250 men, including any men who had run the risk of

infection. Of the 250 men examined seven were positive, terminal-spined ova being in the urine. In five of the seven cases blood was also present. Pte. Br. and Pte. R. had no history of hæmaturia and appeared to be perfectly well, but both admitted exposure to infection. Microscopical examination of the urine showed they were positive for bilharziasis. I am unable to say whether they developed hæmaturia after admission to hospital. Of the eleven officers examined on March 7, 1917, all were negative.

The symptoms of hæmaturia appeared to be brought on by the marching across Sinai. Men would report sick on the morning following a long march. Several cases reported sick with backache some weeks before the appearance of symptoms of hæmaturia. It is interesting to note that although four men might be infected when bathing together in the same spot, there might be a difference of twenty days in the incubation period before hæmaturia started, although the conditions as regards marching were exactly the same. Another point of interest is brought out by these cases. Although at least eighty men in the battalion admitted they had run the risk of infection on at least one occasion by bathing in the Sweet-water, only twenty-two cases developed. These were mostly group cases; for example, four men, all of whom had bathed together in the same spot on the same day, all became infected. This, in my opinion, shows that the miracidia were fortunately not present everywhere in the Sweet-water; and that to have bathed frequently would certainly have carried infection. This is borne out by the high percentage of infection amongst the natives in Lower Egypt, where from one-third to ninety per cent of the fellaheen population are infected. If men bathed together in a place where miracidia were present (presumably hatched out from eggs passed in the urine of an infected native) all developed the disease. Infection was more certain in infected pools and cisterns where infected natives had urinated when bathing, than in a fast flowing stream.

The infection was certainly a skin infection and not conveyed by drinking the water.

History of Some Typical Cases of Bilharziasis among 1/4 *Northamptons.*

Class A.—(1) Pte. R. 2204. Arrived in Egypt in April, 1916. Stated that in the last week of May, 1916, he bathed once in the Sweet-water Canal with Pte. C. In January, 1917, he reported at sick-parade with backache; this backache continued for two months, but he remained on duty; hæmaturia started on March 7, 1917, on which date he was sent to hospital. Positive for bilharziasis.

(2) Pte. C. Bathed in the same spot as Pte. R. Hæmaturia after marching on February 28, 1917. Positive for bilharziasis.

(3) Pte. W. Arrived in Egypt, February, 1916; bathed in Sweet-water Canal once in last week of May, 1916, when he went fishing with Pte. B. Hæmaturia, March 5, 1917. Positive for bilharziasis.

(4) Pte. B. Fished with Pte. W. Reported sick, with hæmaturia on January 20, 1917. Positive for bilharziasis.

(5) Pte. E. Arrived in Egypt in February, 1916; bathed in Sweet-water Canal during last week of May, 1916, with three other men of the same battalion, Ptes. T., J., M. All these men subsequently developed bilharziasis. Pte. E., March 6, 1917; Pte. M., March 7, 1917; Pte. J., November 23, 1916; Pte. T., November 26, 1916.

(6) Second Lieutenant W. Went fishing with his servant, Pte. Es., on June 4, 1916, in the Sweet-water Canal but did not bathe. Stated he got his feet wet by slipping into the water from the bank. It is interesting to note that the cercariæ evidently passed through Second Lieutenant W.'s puttee. Second Lieutenant W. reported sick, with hæmaturia after a long march on March 31, 1917. Stated he had had occasional hæmaturia for the previous two months. Reported positive for bilharziasis.

(7) Pte. Es. Went fishing with Second Lieutenant W. on June 4, 1916, and stated he once bathed in the Sweet-water Canal. Hæmaturia January 16, 1917. Reported positive for bilharziasis.

List of Hospital Admissions for Bilharziasis, 1/4 Northamptons, 1916-1917.

Reg. No.	Name	Date sent to hospital
5410	Lance.-Cpl. J.	23.11.16
5404	Pte. T.	26.11.16
3881	Pte. P.	26.11.16
1813	Lance.-Cpl. S.	29.12.16
4836	Pte. L.	6.1.17
5415	Pte. D.	10.1.17
5417	Pte. Es.	16.1.17
2449	Pte. B.	20.1.17
3992	Pte. G.	6.2.17
5136	Pte. V.	11.2.17
4151	Pte. As.	13.2.17
2433	Pte. C.	28.2.17
5425	Pte. E.	6.3.17
4357	Pte. De.*	6.3.17
4054	Pte. Je.	6.3.17
4040	Pte. Ba.	7.3.17
10868	Pte. Br.*	7.3.17
2204	Pte. R.*	7.3.17
3844	Pte. M.	7.3.17
2244	Pte. F. W.	7.3.17
—	Second Lieutenant W.	31.3.17
?	Pte. A.	25.4.17

All these were cases of vesical bilharziasis with terminal-spined ova. There was a history of hæmaturia, except in the cases of Ptes. Br., R., and De.

Class B.—Three cases infected from washing in the cattle trough at Kubri.

Pte. D. Arrived in Egypt in May, 1916; never fished or bathed in Sweet-water Canal, but he washed in cattle trough at Kubri, near battalion football ground, in June, 1916. He reported sick, with backache for three weeks, which was continuous. He never passed blood. He was sent to hospital and was diagnosed as bilharziasis microscopically on March 6, 1917.

Pte. J. Arrived in Egypt in September, 1916; never bathed or fished in the canal, but washed in water taken from the Kubri cattle troughs. Stated he had had occasional hæmaturia for two months before he reported sick; was sent to hospital March 6, 1917, and diagnosed microscopically as bilharziasis.

Pte. A. Never bathed or went to the Sweet-water Canal, but washed in cattle troughs the first week in June, 1916; hæmaturia started in March, 1917. Was sent to hospital and diagnosed as bilharziasis, April 25, 1917.

There were no cases of rectal bilharziasis. The lateral-spined ova of *Schistosoma mansoni* were never present, nor did we find *P. boissyi* in the Sweet-water Canal.

II.—Discovery of Bilharziasis amongst the Orange Groves of Mulebbis, 1918.

Mulebbis is the flourishing Jewish colony north-east of Jaffa. It was occupied by the East Anglian Division after the battle of Bald Hill on December 24, 1917. Our information, as already noted, had been that no bilharziasis existed in Palestine, and that *B. contortus* snails were not found in this neighbourhood; but after the unfortunate experience of the Northamptons on the Suez Canal, we were always alert for the possibility of bilharzial infection, although the order with regard to bathing had been discontinued after the crossing of the Sinai Peninsula.

In February, 1918, I took over the duties of brigade sanitary officer; and in connexion with the strenuous anti-mosquito campaign started at this period under the able management of Colonel Fowler, it was my duty to examine all wells, cisterns and marshy areas. These wells were marked on an enlarged 1/20,000 map, and numbered with a number and letter indicating the area they belonged to. This was first done by boards, but these were frequently stolen by Bedouin, and it was found better to paint—in the dry season—the letter and number on the well or cistern itself. Cresol formed a useful substitute for paint. These places were visited weekly, and a register kept showing the date of visit, whether oiled, presence of larvæ, or anything else of interest.

On February 10, 1918, Cpl. Loveday and myself were visiting a cistern in an orange grove belonging to Madame Pascall, map. ref. Selmeh 1 in 20,000, F.26, B.55, a mile south-west of Mulebbis, on the left-hand side of the Jaffa-Mulebbis road; a few days after we had started the anti-mosquito work. The orange and lemon groves with which Mulebbis is surrounded are each irrigated from large cement cisterns, resembling school swimming baths, the water is pumped into them by modern machinery from an adjacent deep well. These cisterns are often never completely emptied for seven or eight years.

A few cisterns contain fish placed there by their owners with the object of keeping down mosquito larvæ. These fish appeared to be Egyptian perch and were usually three or four ounces in weight. I do not consider that they were of much use. The fish were too large, and anopheline larvæ were very seldom found in any open cistern. Culex more commonly bred there, but these open cisterns were not the favourite breeding spots for mosquitoes. On the other hand the small fish about the size of a minnow found in the springs and swamps of El Mirr certainly keep down the larvæ, and may be observed to do so experimentally. Madame Pascall's cistern contained a few of the large fish, also culicine larvæ, and to our surprise a number of *B. contortus* snails crawling on the bottom and sides of the cistern among the algæ with which the bottom was covered. The snails were sent to Major Austen, who identified them as *B. contortus*; he had not, however, the facility for examining the snails' livers to prove their infection.

Between February and August, 1918, we examined daily hundreds of cisterns, wells, swamps, and mosquito breeding places, including the River Auja. But although we searched most carefully we only found the *B. contortus* in three of these open cisterns near Mulebbis, in one deep well adjacent to a cistern, and in a pool near the village of Kafrana, though limnea snails were most plentiful, especially in the River Auja. Major Austen found *B. contortus* in Burak-Leil only, a pool near El-Jelil, subsequently obliterated in course of anti-mosquito operations by 21st Corps.

Three cases of bilharziasis were traced to Madame Pascall's cistern, and one to another cistern half a mile north of Mulebbis, which also contained bullinus snails. These cisterns were all treated with cresol, danger boards posted, and a guard placed over them: they were also emptied.

I am unable to explain why these particular snails should only be found so locally, and cannot be found in the River Auja or in the wadi pools with the two exceptions already reported.

As soon as we had discovered the snails we went to the manager of the estate, Bornstein, who lived in this garden, and found that both he and the native boys working in the garden all had symptoms of bilharziasis. Their histories are most interesting and are appended. The same evening we procured specimens of urine from these cases, and rode into Jaffa in the hope of finding a microscope there. Captain Stewart, of the 77th Casualty Clearing Station, very kindly confirmed the diagnosis in each case, and found the terminal-spined ova of *S. hæmatobium* without even the necessity of centrifugalization.

History of the Mulebbis Cases.
(*Infected Jews.*)

(1) B., a Russian Pole, aged 35, who had worked near Mulebbis for the last twelve years, and always lived there, stated that two years ago he had hæmaturia, but was now "cured by drinking plenty of cognac." He had

never been to Egypt, but had washed and bathed in Madame Pascall's cistern. He said that the Arab boys, who came from El Yehudie, after working on the estate for about a year always passed blood. That in the summer they swam in the cistern. He remembered that seven years ago an Egyptian native was employed in the orange grove who had hæmaturia; there was never any case as far as he knew before this. The cistern had not been completely emptied for eight years. Captain Stewart, 77th Casualty Clearing Station, reported that B.'s urine teemed with terminal-spined ova of *S. hæmatobium.*

(2) M., aged 20, a Jew, lived all his life in Mulebbis; has an orange grove next to Madame Pascall's. Three years ago he swam in Madame Pascall's cistern; six months later he passed blood after micturition; was sick for two years, but stated that he cured himself by drinking cognac. Captain Stewart reported the presence of many terminal-spined ova, also blood in the urine.

(3) G., a Jew from Mulebbis, stated that he had never been in Egypt; born in Poland; had lived in Mulebbis the last fifteen years, worked in Madame Pascall's orange grove, and bathed in her cistern with the Arab boys there six years ago; some months later he passed blood after micturition. He is thin and anæmic. He saw a doctor in Jerusalem four years ago who told him he had bilharziasis and that if he drank plenty of cognac it would cure his complaint; has not had hæmaturia the last two years, and says he is cured. Captain Stewart reported that no ova were found, but many oxalate crystals were present.

(4) G., a Pole, aged 17; born in Poland; has lived in Mulebbis for the last seven years, and works in the orange groves, but has not worked in Madame Pascall's; bathed in cisterns in the summer, but has not bathed in Madame Pascall's; never had hæmaturia. Captain Stewart reported him negative for bilharziasis.

(*Infected Arabs.*)

(5) H. I., Arab boy, aged 15; lived all his life at El Yehudie and worked in the orange groves; for the last six years at Madame Pascall's orange garden. During the last three years has passed a few drops of blood after micturition. Was paddling in Madame Pascall's cistern at the time of our visit; admitted he had urinated into cistern. Reported positive by Captain Stewart.

(6) A., aged 13, has worked in Madame Pascall's orange grove for the last five years, and passed blood four years ago; now works in another orange grove; is very sick and anæmic. Reported positive by Captain Stewart.

(7) M., Arab, aged 16; lived all his life at Kafrana, and worked in the orange groves of Mulebbis; has bathed in several cisterns, but never in Madame Pascall's. Has bathed in cistern 7B. Stated does not pass blood.

Reported positive by Captain Stewart. 7B was a cistern in an orange grove half a mile north of Mulebbis, which contained *B. contortus* snails. The snails were also present in the neighbouring deep well. The well was uncovered, but the snails in it were less likely to be infected than those in the open cisterns where the Arab boys bathed. The snails in the well were identified by Major Austen as *B. contortus.*

(8) Y., an Arab, aged 20; lived all his life at El Yehudie, and worked in Madame Pascall's orange grove, but never bathed or drank from the cistern because he "knew it was bad water"; no history of hæmaturia. Urine reported negative by Captain Stewart.

Prevention.

(1) All infected cisterns, including thirty others in the vicinity, were emptied. The water was first treated with cresol: one cubic centimetre to four gallons of water. The infected cisterns, until they were emptied, were labelled "Dangerous to handle this Water," and a guard was posted over them.

(2) The anti-malarial squads were warned of the danger of handling these snails, and were told to drop the snails into 1 in 10,000 cresol solution. Rubber gloves indented for were not available.

(3) Strict divisional and battalion orders were published forbidding men washing or bathing in these cisterns except in the Auja, where no bullinus snails could be found, though limnea snails were exceedingly plentiful. I am quite unable to explain why we were unable to find bullinus except in the places mentioned. There were none in the Abuzeitun Marsh, although we searched for them daily.

Instruction.

(4) Lectures were given to every battalion, which it was compulsory for officers and N.C.O.s to attend, and at which bullinus snails were shown. In addition there were lectures on malaria, relapsing fever, and fly prevention. Small exhibitions were opened in Mulebbis and Wilhelma, and an orderly conversant with the work was always on duty to explain the specimens shown and the diagrams exhibited. We were surprised at the amount of interest the men took in this work. Moreover, these places were constantly visited by all ranks as well as by Jews in Mulebbis, who, although they had the most primitive ideas with regard to sanitation, were keenly interested in the prevention of these diseases.

Summary.

(1) The Mulebbis outbreak of bilharziasis was very localized. We examined the Jews in Mulebbis who were working in the orange groves, but with the exception of the cases reported none were infected. We also examined Arabs from El Yehudie and Kafrana and found them negative

with the exception of those reported. Bullinus snails were only found in one pool out of many near these two villages, and there was no evidence to show that this was infected. Bullinus was only found in one other pool by Major Austen.

(2) We never found the lateral-spined ova of *S. mansoni*, nor did we find the host of the rectal form of bilharziasis, *P. boissyi*, in the Mulebbis area.

(3) There are possibilities of the spread of bilharziasis in Palestine. During the war there must have been many bilharziasis carriers, especially among the Egyptian natives of the Egyptian Labour Corps and Camel Transport Corps.

A spread of bilharziasis would be disastrous for Zionism and for the many colonists who will settle in this fertile country. Very stringent measures are required to prevent this. The greatest care should be taken to prevent infected persons from urinating or defæcating near water, and so prevent the ova hatching out. The orange grove cisterns should be emptied and cleaned annually, and bathing in them prohibited. The Arabs and Jews working in them should be systematically examined. Special care should be taken not to employ natives who are infected or who come from infected countries. This local outbreak can be entirely traced to an infected Egyptian native employed seven years previously, and well illustrates this danger.

Every facility was given by Madame Pascall and by the Jews in Mulebbis to conduct this research.

III.—A Localized Outbreak of Malignant Tertian Malaria at a Desert Post in Sinai in 1916: Infection by Single Mosquito.

History of Outbreak.

The 1/4 Northamptons were stationed at Kubri in Sinai doing canal defence duty in the Southern Sector in June, 1916. There had not been any previous cases of malaria in the battalion when in Egypt.

On June 25, 1916, two officers, Lieutenant D. and Lieutenant B., with 140 men, were sent from the desert post at Kubri to garrison Baluchistan post, which consisted of trenches and a few mud huts on the eastern bank of the Suez Canal, two miles south of Kubri. This post had been built and garrisoned previously by a detachment of Gurkhas who were known to be malaria carriers. On July 8, 1916, Lieutenant D., one of the two officers, was thrown from his horse, and was admitted to the 18th Stationary Hospital at Suez with a fractured collar-bone. When in hospital on July 10, 1916, he had a rigor, temperature 106° F., and was diagnosed microscopically as malignant tertian malaria.

On July 9, 1916, Lieutenant B., the remaining officer, had a rigor, and was sent to hospital. He was diagnosed as malignant tertian malaria. Both were primary cases. There were no further cases at this post.

Method of Infection.

We inspected the post carefully on July 9, 1916. These two officers both slept in the same dark mud hut. The rafters of this hut were carefully searched and we discovered and killed a female speckle-winged anopheline mosquito, *A. pharoensis*.

The best method of catching mosquitoes was taught me subsequently by Colonel Fowler, and was extremely useful in searching native huts. A flash lamp was used, and a piece of cotton-wool saturated with chloroform was placed at the bottom of an empty shaving-stick box. This was used to slip over the resting mosquito and enabled one to preserve the specimen for identification later. The men of the garrison of Baluchistan Post slept in the open; none complained of being bitten by mosquitoes. The water supply of the post was brought from Kubri by barge and stored in two large covered tanks : at the time of inspection there were small pools under these tanks where the water had dripped, but we were unable to find any anopheline larvæ. Subsequently the tanks were abolished and a pipe system from Kubri substituted.

A careful search was made subsequently for adult mosquitoes, but no more were discovered after the first visit. The men at the post were paraded on two consecutive days weekly for the following six weeks, and given fifteen grains of quinine sulphate at each parade as a prophylactic. None of them contracted the disease.

Conclusions.

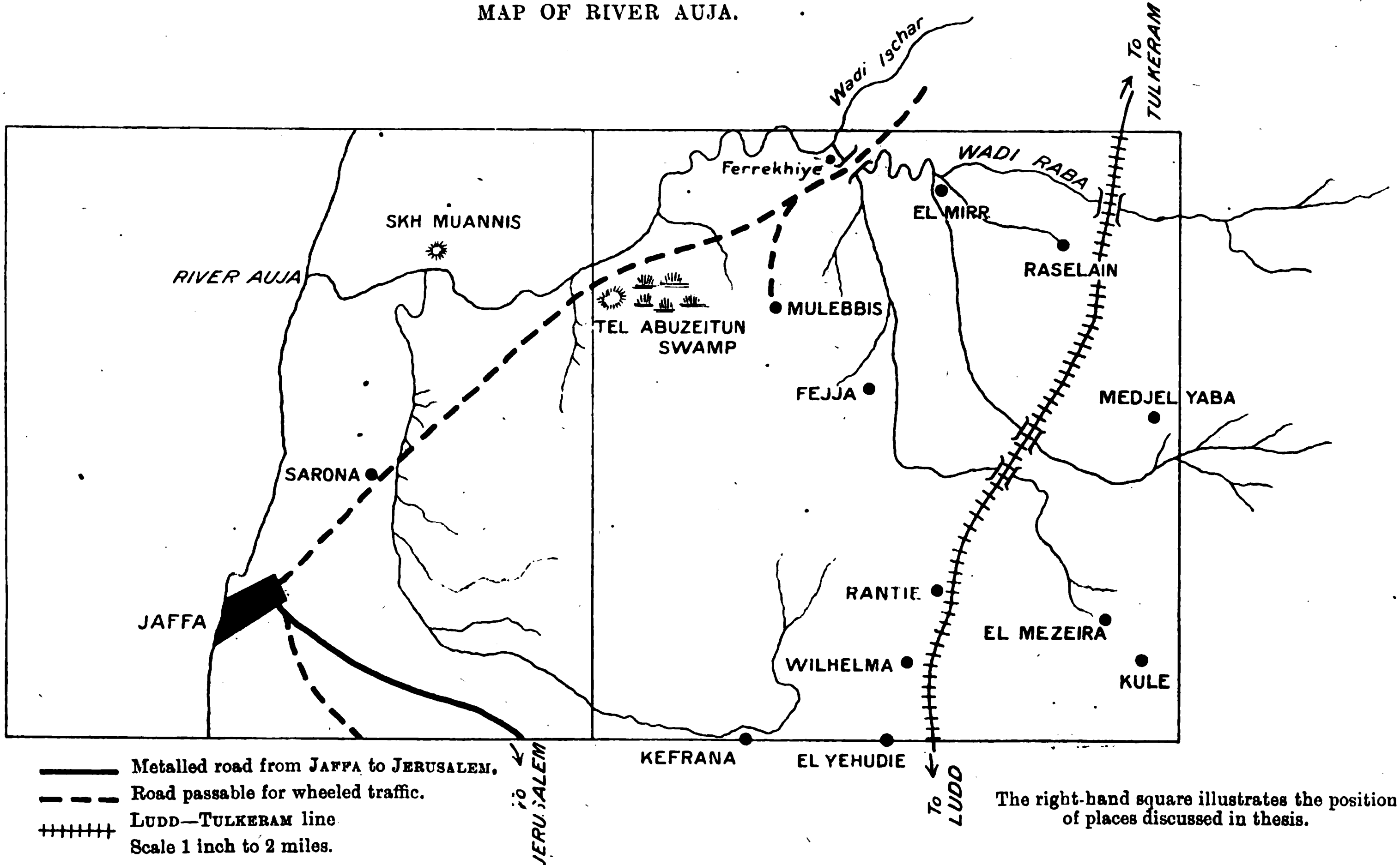
The infected anopheline mosquitoes were probably brought by the water barges from Kubri. There was a swamp on the western bank three miles away where anopheles were breeding at the time, and a serious outbreak occurred among Hyderabad Lancers who were stationed near the swamp. This was investigated by Captain Bahr and anti-mosquito measures were taken.

The only subsequent case in the battalion at the Kubri camp was on June 26, 1917, when Serjeant S. was bitten by a mosquito on the train journey to Suez, twelve days before his admission to hospital. The diagnosis was malignant tertian malaria.

IV.—Anti-mosquito Work in the Vicinity of the River Auja in the Spring and Summer of 1918.

The area under observation from February to August, 1918, discussed in this paper is approximately eight square miles, and is shown on the attached map. It contains the prosperous Jewish colony of Mulebbis, the German agricultural colony of Wilhelma, and on the plain the native villages of Ferrekhiye el Mirr, Fejja, Rantie, Nebitari, El Yehudie, and Kafrana, while east of the Ludd-Tulkeram railway line in the rocky high

MAP OF RIVER AUJA.



Metalled road from Jaffa to Jerusalem.
Road passable for wheeled traffic.
Ludd—Tulkeram line
Scale 1 inch to 2 miles.

The right-hand square illustrates the position of places discussed in thesis.

ground are the villages of Medjel-Yabà, Mezeirah and Kule. These hill villages are quite different from the villages on the plain.

The northern boundary of this area was the River Auja, which rises among the ancient ruins of Ras el Ain, held at this period as one of our strong posts in the Auja line of defence, and occupied by the East Anglian Division during these months.

The Auja rises by a great number of small springs; in winter the flat ground between Ras el Ain and El Mirr is very boggy and almost impassable. These springs are a hotbed of anopheline larvæ, which are present in numbers in the clear water away from the swift-flowing current, sheltering beneath the papyrus roots or under old tree stumps. They can best be found by scooping up the water with a white enamel soup ladle. The Auja banks were covered in March with thick high vegetation, five feet in height: there were many overhanging trees and willows projecting into the stream, under which anopheline larvæ could be found. They were more frequent, however, in the springs and shell-holes when these were sheltered by vegetation. At the village of El Mirr the Auja is joined by the Wadi Lejja on the south, while at this spot on the north it is joined by the Wadi Raba. Two miles farther west the Wadi Ischar joins it from the north.

These wadis began to dry up in the hot season, and by April consisted of a chain of pools, some of them sixty yards long and four feet deep. These pools, surrounded by high grass, were a very favourite breeding place for both culicine and anopheline larvæ. In the pools in the Wadi Lejja many of the anopheline larvæ were bright green, possibly because they fed on algæ. These green larvæ were very delicate, and we were never able to bring them home alive to hatch them out, although we tried keeping the bottles cool with a wet flannel jacket.

The River Auja was part of our front line, and both Ras el Ain and Medjel Yaba were daily shelled. On one occasion several men belonging to an anti-mosquito working party were wounded here.

The Wadis Ischar and Raba were in front of our line, and it was necessary to take an armed guard when doing anti-mosquito work on these wadis. The Royal Army Medical Corps personnel and the anti-mosquito squads of the battalions in the line carried out their work very thoroughly and often under difficult conditions. Serjt. Miller of the Sanitary Section did especially valuable work.

One of the most difficult problems was the Abuzeitun Marsh on the southern bank of the River Auja, three miles west of Mulebbis. In the hot weather this marsh was four hundred yards square, with many springs. It consisted of a peaty, quaking bog, covered with sedge, and somewhat resembled parts of Wicken Fen. This was the worst mosquito breeding spot in the area. Anopheline larvæ could always be found in this marsh, and were only kept down by very vigorous anti-mosquito work. ***A. sinensis, A. algeriensis*** and ***A. maculipennis*** adults—the two latter, first

identified by Major Austen, could also be found here, occasionally in great numbers. In July, when examining with Colonel Fowler a small native cistern adjacent to a native house near the marsh, we found the wooden walls which covered the cistern almost black with adult maculipennis mosquitoes. *A. maculipennis* hatched out a month later than the other two varieties.

Mulebbis was not occupied by our troops until December 24, 1917, after the battle of Bald Hill, and Medgel Yaba was not captured by the 1/10 Londons until March 12, 1918.

The native population was completely evacuated from Ferrekiye, El Mirr, Fejja, Nebitari and Rantieh, and the German colonists from Wilhelma were sent to Jaffa.

The remaining native villages remained occupied. Our troops were billeted as far away from these villages as possible, and were hidden chiefly in orange groves and among olive trees. They were also billeted in Wilhelma and in Mulebbis.

Organization of Anti-mosquito Campaign.

From January 26, to February 2, 1918, Major Austen came down into this area to investigate mosquito breeding and to instruct the sanitary officers in charge of the work. He spent five days at Mulebbis as a centre, and three days at Wilhelma, and examined 65 wells and 47 cisterns in the area, but 30 wells and 11 cisterns were dry. During this period he did not find a single anopheline larva, although twenty-six per cent of the wells at Sarona nearer the coast were breeding them. Breeding did not start in the Mulebbis area until nearly a month later than in the coastal sector at Sarona.

This area was divided up into four sectors and placed under the three brigade sanitary authorities and the divisional sanitary officer At first these officers moved their areas whenever their brigade moved, but this was found to be an unsatisfactory arrangement and interfered with the oiling and the anti-mosquito work. Later a divisional anti-mosquito officer was appointed, who did not have any sanitary duties, but devoted his whole time to anti-mosquito work. He was in charge of the River Auja, the wadis and the Abuzeitun Marsh, and supervised the anti-mosquito work of the brigade sanitary officers. Each brigade sanitary officer residing at an advanced dressing station had under him an anti-mosquito squad, consisting of an N.C.O. and six specially trained men, whose duty consisted in finding and labelling wells and breeding places, and oiling them. Their equipment consisted of 2 buckets, 100 feet of rope, 6 hand syringes for spraying, and 6 white-enamelled iron soup-ladles for examining water for larvæ. There was an ample supply of paraffin and green oil available for spraying. In June the malaria question became so acute owing to the difficulty of keeping anopheline larvæ in check, that it was found necessary to train six further men in each infantry battalion for anti-mosquito work.

These men carried out their duties in the front line, often under fire, under the supervision of their battalion medical officer.

Routine employed in examining a Well or Native Cistern.

At least three dips were made with the bucket lowered into the well, and the water in the bucket was then ladled out and examined. I do not consider that this was a thorough examination, because we have found anopheline larvæ present in a native cistern after nine successive negative dips. The larvæ dart to the sides of the cistern as the bucket hits the water; moreover, these native cisterns in the rocky hills stretch for many yards underground.

Clerical Work.

Malarial registers were kept by all battalion medical officers, who had to report weekly to the A.D.M.S.: (*a*) the number of men on the register who had had malaria; (*b*) the number of men undergoing three months' quinine treatment. In addition, the regimental medical officer had to notify the A.D.M.S. of any suspected case of malaria sent to hospital, showing where the man had been stationed during the previous fortnight, and indicating whether he was a primary or secondary case, and whether he had taken his three months' quinine treatment after leaving hospital. He had also to report whether mosquitoes were present in the vicinity.

The brigade sanitary officer in charge of his anti-mosquito area kept a register of wells, cisterns and breeding places, which were mapped and labelled, and rendered a weekly return to the A.D.M.S., showing wells oiled and the presence of larvæ. He had to prepare a map of his area. The 1/20,000 maps were enlarged four times and then were charted with wells and cisterns. The A.D.M.S. at his office kept spot maps showing where primary and secondary cases of malaria occurred. These maps were flagged to show the positions where anopheles were breeding at certain dates, and also the location of cases of malaria in the division.

Method of Oiling Wells.

Wells that were not in use for drinking were sprayed every seven days with equal parts of paraffin and green oil by means of a hand spray, until there was a thin scum of oil floating on the surface. If the wells were used for drinking purposes, the green oil was omitted. Cattle would not drink water sprayed with the green oil, which was heavy and sank to the bottom.

At first wells were oiled every ten days, but we found by experiment that this was not sufficient to prevent the larvæ breeding in the wells again. Stitt, in his "Tropical Diseases," p. 33, says that once a fortnight is sufficient, but this we found to be inadequate. It was useless to oil swamps unless the reeds had been cut first or burnt down. In oiling the swamps at Abuzeitun, half a dozen natives were made to spray in a line; but the natives, whether Egyptian or Indian, were not reliable, and had to be constantly watched.

Drip cans were not a success. For oiling channels we tried sinking a sandbag containing tow saturated with green oil and paraffin. Another method was the sealing of native wells, undertaken by the R.E.; and some wells were pumped dry. We found that mosquitoes did not breed in orange grove wells which contained rotting oranges, for the oily scum on the surface formed a natural method of oiling.

Clearing Vegetation and Canalization.

Pools and shell holes were filled in on a large scale; hundreds of men were employed on this work in the spring of 1918.

The pools left in the wadis, a very favourite breeding place, were filled in. Some of these were sixty yards long by four feet deep, and protected by high grass. The Abuzeitun Marsh was one of the most pestilent and difficult places to drain. A large median drain was cut, after the sedge had been burnt, and branch drains were cut every four yards. The main drain ran for three miles until it emptied into the River Auja; this facilitated the oiling of the marsh. This work was done mainly by natives of the Egyptian Labour Corps. The River Auja was cleared admirably by the 34th Sikh Pioneers from its source at Ras el Ain to the village of Ferrekiye. All roots and tree stumps were removed from the river. The bank was completely cleared for six feet up on either side, and springs were canalized. The Wadis Ischar, Raba and Lejja were treated in a similar manner.

Varieties of Mosquito Breeding Places.

(1) *Orange Grove Cisterns*, resembling open swimming baths, were practically never infested by anopheline larvæ, but about four per cent contained culicine larvæ. There was no protection for larvæ.

(2) *Orange Grove Deep Wells.*—These were deep wells from which the water was pumped by machinery into the cisterns. There were two types of well, that in the Sarona district being often arched over, with a dwelling-house above it, in which natives live who tend the gardens.

Twenty-six per cent of these wells near Sarona were found by Major Austen to contain anopheline larvæ as early as the end of January, 1918. On the other hand, the wells in the Mulebbis area, which were more exposed and had no natives in their vicinity, did not contain anopheline larvæ in January or February, 1918, and very few ever became infected. This, in Major Austen's opinion, may be due to the fact that Sarona is nearer the coast, and there may be a coastal species of anopheles in the wells there; or perhaps the Sarona wells are more protected than those at Mulebbis and have natives living near them.

(3) *Native Cisterns.*—These are found in the hilly country east of Ludd-Tulkeram line, and are very numerous, as many as fifty or sixty being found near each native village. They are not true wells, but are artificially cut out of the limestone rock. In some cases, as at Mezeirah, they hold up to 28,000 gallons. They extend many yards underground, and have

several rounded openings, from one to three feet in diameter. The water, probably rain water from the rocks, is very soft; the chlorination figure averages from three to five parts per million. These cisterns are difficult to discover, as their mouths are closed with stones.

Nearly all these native cisterns in May, 1918, if untreated, were breeding culicine mosquitoes, and ten per cent of them also were breeding anopheline mosquitoes. When these cisterns were disturbed, the mosquitoes would buzz out in swarms. On March 21, 1918, at Mezeirah, out of 60 native cisterns, 3 were breeding anopheline larvæ, and 2 of these cisterns were in the centre of the village; but by April 11, 1918, after oiling, the larvæ were stamped out.

Another interesting fact was that, although as a rule anopheles preferred to breed in clear water, at Mezeirah the worst breeding place was a well in the centre of the village where the water was most offensive, and contained, in addition to the body of a dead Turk, the larvæ of anopheles, of *Culex pipiens* and of *Theobaldia longiareolata*, identified by Major Austen.

Anopheline larvæ were more sensitive than culicine larvæ. We were never able to get them to live in the cow urine from the pits in Wilhelma, although culicine larvæ thrived in it. Nor could we get anopheline larvæ to live in the effluent of soapy water, containing a little cresol from the Wilhelma baths, although we constantly found culicine egg rafts in this effluent.

(4) *Pools left in the Wadis.*—These were some of the worst breeding spots, when protected by high vegetation and rushes, and were therefore filled in. Fortunately many of them, especially in the vicinity of Kafrana, dried up by May, 16, 1918. In July, 1918, a small wood on the Wadi Ischar was a favourite shelter for adult maculipennis mosquitoes, which had hatched out of the pools.

(5) *Auja River.*—Anopheles were found to be breeding here in the middle of March, both in sheltered spots out of the current and under tree-stumps, or where there was a spring. Anopheline larvæ were most frequent in the clear springs and back waters at Ras el Ain under the papyrus roots.

(6) *Swamps.*—These were very common breeding places. Most of the swamps were infected by May, especially at Abuzeitun and in the vicinity of El Mirr, though no anopheles were breeding on January 27, 1918. The Jews had made successful attempts to drain swamps by planting eucalyptus trees in some places. This plan should be extended. They also believed that eucalyptus leaves were a protection against malaria, and in their public steam bath at Mulebbis placed boughs of eucalyptus trees.

(7) *Shell holes* and ablution holes, made to contain a waterproof sheet as an extempore bath, often bred both culicine and anopheline mosquitoes. Larvæ were also found in the front-line trenches, which on February 28 1918, contained nearly a foot of water. Several cases of malaria among a company of the 1/5th Norfolks at the end of February were due to an infected swamp within ten yards of the company headquarters.

Isolated cases occurred in March and May in the vicinity of mosquito breeding areas, among the troops holding Medjel Yaba, in the vicinity of Mezeirah and at Ras el Ain. There were also a number of cases in June, 1918, among the Essex Regiment, who were billeted in a wood within half a mile of some infected pools in the Wadi Lejja, near a spot called Lemon Post. No primary cases occurred in Wilhelma, and, thanks to anti-mosquito work, no anopheline larvæ were found from February to July, 1918, in Wilhelma, El Yehudie, Kafrana or Rantie. There were consequently few primary cases among the troops here, though breeding was at its height in June in unprotected areas.

(8) *In water tubs and butts and cattle troughs* at Wilhelma and Mulebbis, on April 29, 1918, culicine larvæ were breeding freely. These tubs had to be emptied. Anopheline larvæ were found in a water-butt at Mulebbis on April 29, 1918. We also found adult maculipennis in the houses there, and an affected deep well. There were several primary cases of malaria in Mulebbis during May and June. We found that in abandoned houses breeding took place in water receptacles left behind in locked-up rooms.

(9) Mosquitoes bred occasionally in irrigated ground in the orange and lemon groves, but breeding was not usual except in the puddles. The water dried up too soon in the hot weather.

Adult Mosquitoes.

Both culicine and anopheline mosquitoes were very common in this area in 1918. Most commonly found in the mouths of the native cisterns.

On July 7, 1918, the walls of the cisterns at a village called Haditheh, Map Ref. Sheet XIV, Y. 13, A. 20, were literally black with adults. Haditheh was a small native village on a hill south of Kule.

Out of 13 native cisterns at Haditheh 4 were dry, 3 were sealed. Of the remainder two contained anopheline and culicine larvæ. There were millions of mosquitoes blackening the sides of these cisterns; two contained culicine larvæ only, with culicine adults on the sides; two contained a few anopheline larvæ only.

The anopheline mosquitoes found in this village were all of the maculipennis variety. These mosquitoes often lived in European houses as well as in native houses, and though none were seen in Wilhelma, we found them in several houses in Mulebbis after June, 1918, and hatched them out from larvæ found in a water tub. *A. maculipennis* was also found in the tops of the bell-tents occupied by troops in the vicinity of breeding places; but the adult mosquitoes were also very plentiful in the Ischar Wood.

In the Abuzeitun Marsh *A. sinensis* and *A. algeriensis* were freely hatching out in May, 1918, and were identified by Major Austen.

We hatched out a number of pupæ from the wadi pools and also from the River Auja near Ras el Ain, and found an unspotted anopheline identified by Colonel Fowler as *A. bifurcatus*, but Major Austen did not

meet with this species. There was also a small speckle-winged anopheline with two white terminal tarsals of its hind legs, which was not identified. Colonel Fowler identified from hatched out specimens: *A. mauritianus*, *A. pharoensis*, *A. palestinensis*, *A. fragilis*. These were also identified by Major Austen, but were not common here.

In the Wadi Ghuzze the two varieties of anopheline mosquitoes were: *A. turkhudi*, *A. palestinensis*. The introduction of small fish in the Wadi Ghuzze was a most successful anti-mosquito measure. Of the culicine mosquitoes *Culex pipiens* and *Theobaldia longiareolata*, with its large black-headed wriggling larvæ, were most common.

Dixa larvæ were very common in the Auja in clear water under papyrus roots or old tree stumps, and were easily distinguished from anopheline larvæ by their lateral wriggling motions and their ability to climb up the side of a glass jar.

Simulium flies were often found with the anopheline mosquitoes; and there were plenty of sand flies in the vicinity of Wilhelma by the middle of July, 1918.

A systematic search was made for adult mosquitoes, and much good resulted from explaining to all ranks the dangers of the mosquito, and the methods of distinguishing it throughout its life history. Many adults were killed and breeding areas reported.

Protection of the Men.

(1) Anti-mosquito ointment was indented for, but the small quantity used was not a success and it was discontinued.

(2) "Salonica" shorts were issued to some units, and these protected the knees of the men on duty at night. Ordinary "shorts" were not allowed to be worn after sundown.

(3) Prophylactic doses of quinine were not given to healthy men, but all cases of malaria returned from hospital were put on a three months, course of quinine treatment—sixty grains per week in solution if possible. This was supervised by the regimental medical officer.

(4) Mosquito bivouacs were issued, one for every two men. They were weighted at the sides with pockets filled with earth, and when used properly were an effective protection for the men at night. They were also cooler than a bivouac of waterproof sheets, but were not available until the first week in June. At first they were improperly used. We found that one battalion had placed wire beds under them, and so prevented the net reaching the ground; the wire was also apt to tear the meshes. Company officers were made responsible, and rigid supervision prevented a repetition of the error.

Mosquito Huts.

On June 14, 1918, we inspected five of these huts on the Auja in use by the 1/5 Essex. They were not mosquito proof, and were badly warped by

the sun. Two of the huts had the gauze windows missing. The sliding roofs were very unsatisfactory and were left open by the men who slept there.

These huts were quite useless, and were discontinued.

The most important protection was to billet men as far as possible from the mosquito breeding places—at least a mile from any native village which was highly infected. Many of the villagers suffered from malaria, and a high percentage of the children had enlarged spleens. The villages placed on rocky high ground were more infected than those on the plains, and had a higher death rate; which was not surprising in view of the greater number of breeding places for anopheline mosquitoes, and the curious custom of disposing of the dead by placing them in rocky caves with a stone rolled over the entrance. This method of burial was practised at Mezeirah within 100 yards of the village; but on the plains the dead were buried in the Mohammedan cemetries.

In conclusion, it is not in the scope of this paper to discuss the number and location of cases of malaria primary and secondary occurring among troops in this area, as it has been impossible for me to obtain the malaria returns. But I think it is clear that the anti-mosquito work done on the Auja definitely proved its value. There were, it is true, cases of benign tertian and malignant tertian malaria in isolated groups in the vicinity of anopheline breeding areas. But as long as our men remained in this protected zone we were able by constant supervision to keep malaria in check. When the troops moved forward in the September advance the epidemic attained alarming proportions and decimated General Allenby's victorious troops during the final advance into Syria. Before the advance we had been able to hold the Auja line, a highly infected area, with a comparatively low hospital admission rate for malaria. General Allenby himself, in July, 1918, inspected the anti-mosquito work done on the Auja, and took a keen interest in it. It was a privilege to take even a small share in this anti-mosquito campaign under Colonel Fowler, and we were well repaid by the knowledge that our work was effective both from a military and a civilian standpoint.

Two conclusions in particular seem to be justified from these experiences during three years' service with the same battalion:—

(1) The necessity of all ranks receiving some training in the prevention of tropical diseases before proceeding on a campaign. This especially applies to the regimental medical officer.

(2) The desirability of a strenuous after-war campaign against malaria and bilharziasis in Palestine if this fertile country, after its happy release from Turkish misrule, is ever again to become "a land flowing with milk and honey," or even a fit place for white colonists to live in.

AIDS TO DEFINITION IN X-RAY WORK.

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An accurate knowledge of the exact situation of a foreign body in relationship to the eye is often a matter of considerable importance to the ophthalmic surgeon. All the types of machine more commonly in use for the localization of foreign bodies in the eye or orbit have some disadvantage. Therefore, some months ago, I set about designing a new form that should incorporate great simplicity with extreme accuracy. It was essential that the definition of the negative should be the best possible, and I therefore investigated the question of the most suitable form of diaphragm to employ.

In all X-ray work, but particularly in ophthalmic X-ray work, one strives to produce negatives showing sharply defined shadows with clear-cut edges. This could easily be obtained, if only all the X-rays that eventually fell on the plate arose from a single point on the anti-cathode of the X-ray tube.

Unfortunately, this is not the case. Formerly, one had difficulty in producing a high-tension current travelling in one direction only. This resulted in primary X-rays being produced in at least two places in the X-ray tube, with a resulting duplication of the shadow and blurring of the edge. But with improved apparatus, valve tubes and X-ray tubes, this difficulty has been overcome and primary rays arise, in every well constituted outfit, from a single point on the anti-cathode. But wherever these primary rays strike objects, for instance the glass walls of the X-ray tube, they set up secondary rays which are also capable of influencing the X-ray plate, and some of these secondary rays can pass, as can be seen in Diagram 1, obliquely behind the foreign body and thus blur the edges of the shadow.

The foreign body "O" lying in the stream of the primary X-rays arising from the anti-cathode "AC" of the tube "T" throws the shadow "S_1." This would be uniformly densely black were it not for the secondary rays "SR" arising from the walls of the tube which pass obliquely behind the object "O" and illuminate the margins of the shadow. And it is for this reason that it is only the central portion "S" that remains densely black. Further, the foreign body "O" shades a portion of the surrounding area from some of these secondary rays, and, therefore, the edge of the shadow, instead of being clearly cut, shades gradually from the deep black of "S" through the slightly illuminated margin "S_1"; and through the slightly shaded zone "S_2" to the fully illuminated surrounding area.

In the diagram, the foreign body is very large and throws a shadow that is so large that a considerable portion of it is entirely free from illumination by secondary rays. A foreign body about half the diameter of the above would throw a shadow only a very small area of which will be free from secondary rays. A smaller foreign body still will have the whole of its primary shadow more or less illuminated; while the minute foreign body, with which one almost always has to deal in ophthalmic work, throws so faint a shadow that its presence may be entirely overlooked.

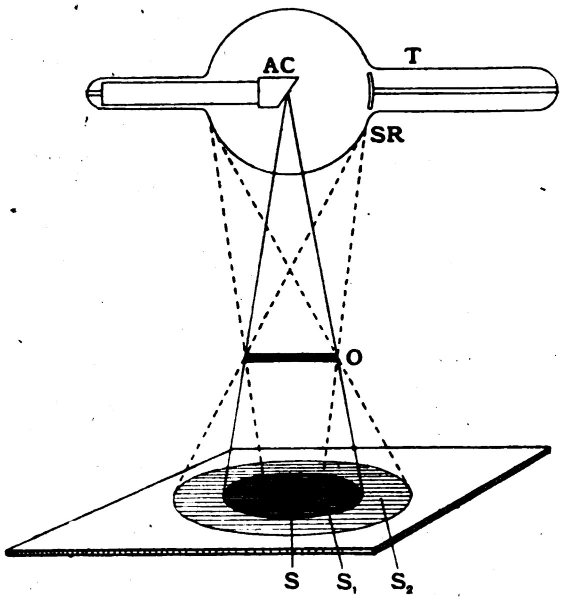


DIAGRAM 1.

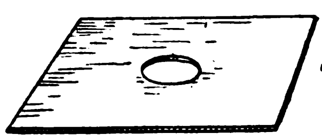


DIAGRAM 2.

DIAGRAM 2A.

In order to improve the definition of the shadow, diaphragms are used. Two types are recognized :—

(1) The ordinary flat disk or plate type, consisting of a piece of material opaque to X-rays in which a central hole has been cut. See Diagram 2.

(2) The tube, cylinder, or cone diaphragm in which in addition to the above, a cylindrical or conical portion of similar material is attached to the edges of the central hole. See Diagram 3.

Diagram 4 shows, that by employing a plane diaphragm "D" the size of the densely black shadow "S" is greatly increased, and that this is brought about by screening off a large area of the tube wall from which these disturbing secondary rays arise.

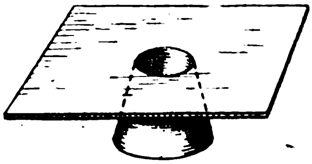


DIAGRAM 3.

DIAGRAM 3A

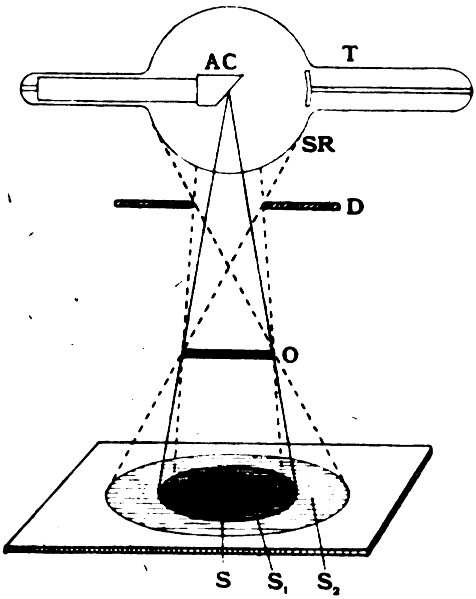


DIAGRAM 4.

It is obvious that the more closely the size of the diaphragm approaches the size of the foreign body, the smaller will be the difference between the densely black area "S" and the partially illuminated area "S_1." For this reason, the smaller the diaphragm the better the definition.

Diagram 5 shows that the employment of a tube, cylinder or cone diaphragm "CD" of the same sized aperture, in no way improves the definition of the theoretical shadow "S_1."

Now it is a matter of common knowledge—a point about which every X-ray worker is agreed—that the definition obtained with a tube diaphragm is superior to that obtained with a flat one, more particularly when dealing with thick tissue such as the head in ophthalmic work, or the hip joint.

Many explanations have, from time to time, been brought forward to account for this superiority of the tube diaphragm, but none as far as I am aware completely satisfies the facts.

As stated above, it is well known that secondary rays arise from any object on which primary rays impinge. Therefore, of course, if the foreign body were lying within a limb, for example, instead of being suspended in the air, many secondary rays would arise from the tissues of the limb, a large number of which would fall on the plate and blur the edges of the shadows. Since, however, the aperture of the plane and the cone diaphragm is the same, it is presumed that the same number of secondary rays would arise in each case. Therefore, one must look elsewhere for the explanation of the superiority of the cone diaphragm.

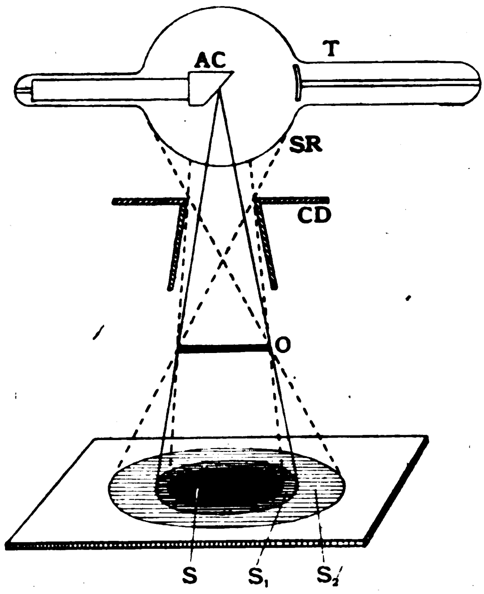
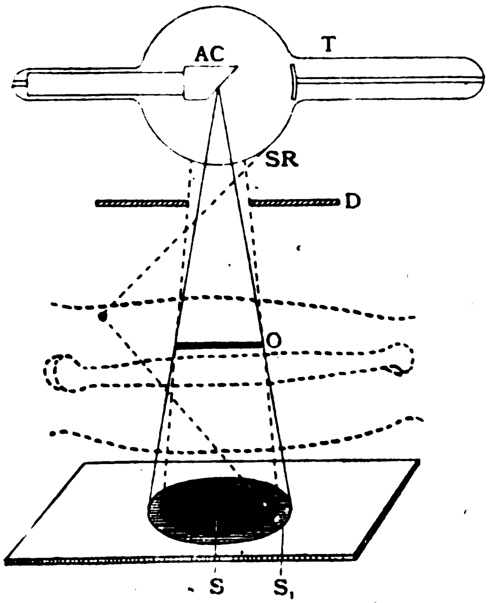


Diagram 5.

The only apparent difference between the two types is the ability of the cone portion of the cone diaphragm to protect the surrounding parts of the limb from the secondary rays arising from the tube walls. Now these secondary rays, when they fall on tissues, set up new rays again, and these conceivably might influence the definition of the shadows. This is clearly shown in Diagrams 6 and 7.

Diagram 6 shows one of these rays "SR" falling on the limb and there setting up new rays which fall on the densely black shadow "S" and reduce its blackness.

Diagram 7 shows how the cone part of the cone diaphragm protects the limb and, therefore, eliminates the possibility of this disturbing ray arising.



DIAGRAM

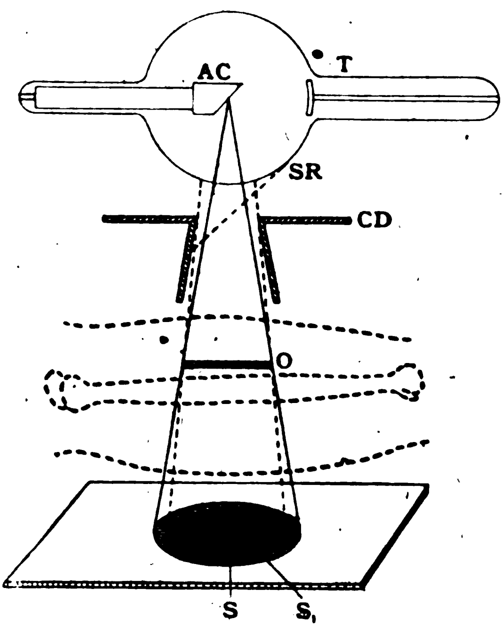


DIAGRAM 7.

These new rays would obviously have only very slight penetrating power, and their capacity for blurring the shadow seemed doubtful, but I saw no other logical explanation of how the cone diaphragm could act in a manner superior to that of the plane diaphragm "D."

But in order conclusively to prove the point, I designed the following experiment.

I employed a large plane diaphragm "D" made of lead three millimetres thick—see Diagram 8—and a lead disk "D_1" also three millimetres thick. This was of such size, and so placed, that no primary X-rays fell on the area "A." In this part, at "P," I placed an X-ray plate "P_1" half of which was covered with a piece of lead three millimetres thick.

I then exposed it for three minutes, with about four milliamperes of current passing through a tube of about Benoist 7, the tube being fifty cubic centimetres from the plate.

I next interposed a patient between the disk "D_1" and the area "A" —see Diagram 9—and exposed another plate "P_2" under otherwise similar conditions.

Now, if the theory suggested above be true, the secondary rays arising from the tube walls will fall copiously on the patient's body, and very many new rays will arise, many of which will fall on the plate "P_2" and will fog the uncovered half, which on development should be quite dark. While the plate "P_1" since there is nothing in this case from which secondary rays can arise, should be entirely free from fog.

When I developed the plates, I found, to my surprise, that nothing of the sort had happened.

The plate "P_1" on development showed slight, very slight fogging of the half uncovered by the lead, while the other half was entirely clear. This showed me that the three millimetres of lead of "D_1" was not enough to cut off all the primary rays, but six millimetres (made up by supplementing the three millimetres of "D_1" with the three millimetres of lead laid on the plate) was ample.

The plate "P_2" was completely free from fog. This showed that the patient's body had made up for the deficiencies of the disk "D_1"; and that no secondary rays had affected the plate. So my theory fell to pieces.

The question then arose, what was the peculiar property of the tube diaphragm whereby one was enabled to obtain with it results superior to those obtained with a plane one?

I next started testing the opaqueness of the ordinary X-ray diaphragm for primary X-rays. And I found, to my great astonishment, that all the plane diaphragms that I tested were incapable of protecting a plate from being fogged by about 240 milliampere seconds exposure with a Benoist 7 tube. These diaphragms were quite capable of screening off all the secondary rays arising from the glass walls of the tube, and some of the softer rays arising from the anti-cathode, but they were penetrated by the harder rays.

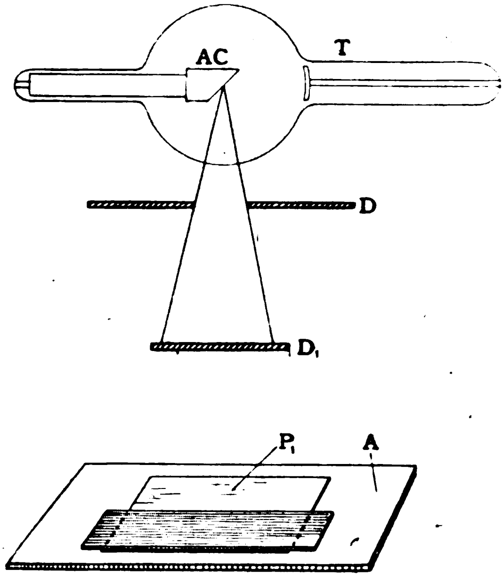


DIAGRAM 8.

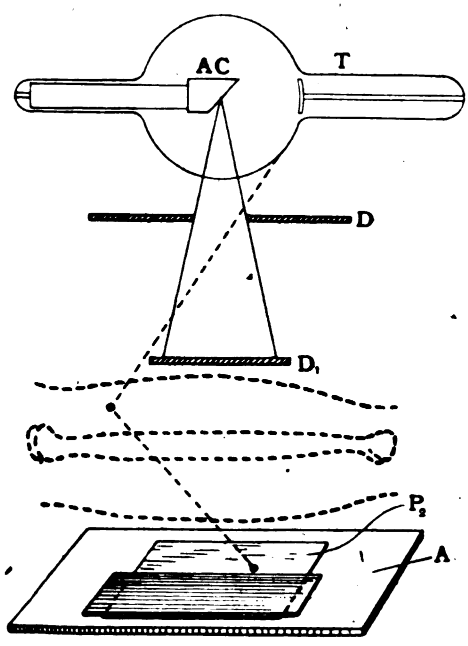


DIAGRAM 9.

I found that it was only when the rays had to pass the entire length of the cylindrical or conical portion of the cylinder or cone diaphragm, that the material was of sufficient thickness to protect the plate, and that it was in this area only that the plate was protected.

If a tube diaphragm of lead glass be placed on a plate so that the normal ray from the X-ray tube passes down its central axis and an exposure be made, it will be found on development that the base of the diaphragm only partially protects the plate, but that there is a clear entirely fog-free ring corresponding to the tube. With this new fact at my disposal, I started using plane lead diaphragms at least five millimetres thick, and with them obtained results just as good as those obtained with a tube diaphragm.

So that it would appear that the true explanation of the superior action of the cone diaphragm is, that owing to the fact that it is quite opaque it entirely protects the surrounding tissues from X-rays.

The ordinary diaphragm allows the hard primary X-rays to pass through it. These enter the surrounding tissue, and there set up secondary rays which blur the shadow.

Diaphragms are usually mounted close to the tube wall. This is done because for any one given sized pencil of X-rays, the nearer the diaphragm is to the tube the smaller may the hole in the diaphragm be, and the smaller the hole the less the area of the tube wall uncovered, and therefore, the less the quantity of secondary rays arising from the wall that can fall on the patient. But, as shown above, the secondary rays arising in this manner are only of the very slighest importance, if of any importance at all. Therefore, this assiduous guarding of the tube wall is quite superfluous.

So long as the tissues are entirely and completely shielded from unnecessary primary X-rays, it is of no practical importance where the diaphragm is placed. It may be convenient, on occasion, to place it in contact with the patient.

I believe the reason for the adoption of semi-opaque diaphragms to be a twofold one.

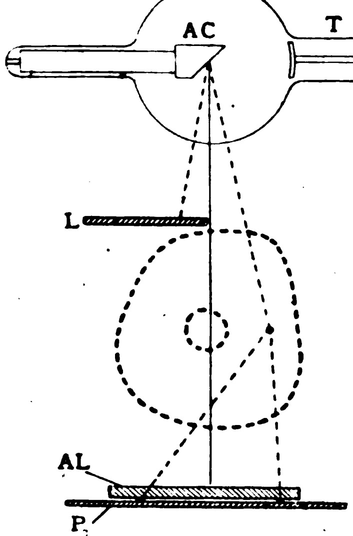
In the first place, if one employs a sheet metal diaphragm near the tube, there is always the risk that it may acquire a statical charge; this may discharge into the tube through the glass wall, thereby perforating and destroying the tube. This may be obviated either by "earthing" the diaphragm, or by mounting it farther away from the tube, which, as seen above, is of no disadvantage.

In the second place, non-metallic material opaque to X-rays is both bulky and heavy, and instrument makers have for years been trying to keep their tube stands and holders as light as possible.

If the above explanation be true, then there must be a great deal of general fog produced by these secondary rays when a thick structure such as a head or hip is being X-rayed.

In order to determine the quantity of this fog, I carried out the experiment shown in Diagram 10.

I placed a sheet of lead "L" about eight millimetres thick between the tube and the patient, so arranged that it shaded half the X-ray plate from the primary rays. I then gave an ordinary exposure. On developing the plate, I was able to see on one half the ordinary X-ray negative, and on the other, where no primary rays had fallen, a general fog which was densest where it abutted on to the radiograph and gradually faded off in those parts of the plate that were farthest under the lead screen.



DIAGRA 10.

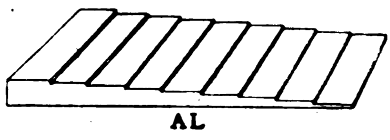


DIAGRAM 11.

These secondary rays are of necessity soft, i.e., of low penetration, and I therefore conceived the idea of filtering them off by means of thin aluminium sheet. In order to determine what thickness would be most suitable, I assembled several sheets, each about half a millimetre thick, in the form of a staircase, as can be seen in Diagram 11. I now placed this between the patient and the plate as may be seen in Diagram 10, where it is labelled "AL." I was thus enabled to determine the effect of screening off various quantities of these secondary rays, both on that part

of the plate where the primary rays fell and on the part where there were only secondary rays. I observed, that within limits, small thicknesses of aluminium cut off some of these secondary rays with resulting improvement in the contrast of the negative. In that part where the aluminium was four millimetres thick, nearly all the secondary rays were cut off. This thickness naturally also cut off some of the primary rays as well, but the total result gave the effect of enhanced contrast, but detail was wanting, as the negative in this area was underexposed.

Many factors enter into the problem, such as:—

Nature and thickness of the part to be X-rayed.

Penetration of the tube and exposure.

Make of plate and type of developer.

Temperature of developer and time of development.

I, unfortunately, have had neither time nor opportunity to bring this part of work to a definite conclusion. I imagine that it will be essential to carry out the experiments with a Coolidge tube, as with no other can one regulate and maintain the penetration with any approach to scientific accuracy.

In conclusion, a cone diaphragm gives clearer, sharper X-ray negatives, because it is more opaque than the other forms, and for no other reason.

A cone diaphragm has three other advantages:—

It protects the operator from the secondary rays arising from the tube wall, should the table not be fitted with the usual opaque aprons.

If the tube be properly centred, the cone diaphragm clearly indicates the size and direction of the pencil of X-rays, and is then very useful, when working from above, in aiding one to determine what area will be exposed to X-rays.

The cone diaphragm can be, and often is, used as a compressor diaphragm, to press the intestines on one side when X-raying the kidney area for example.

(2) I believe that when associated with appropriate exposure and development, the filtering off of some of the secondary rays, as mentioned above, will be found advantageous in increasing the contrast and detail.

———

A GENERAL HOSPITAL CHANGING BASE.

By Colonel S. F. CLARK, (Retd.).
Army Medical Service.

A short account of how the "retreat from Mons" reacted on No. 3 General Hospital in Rouen may be of interest. Although the German advance in August, 1914, did not extend farther than Amiens, yet it was generally supposed in Rouen that the enemy was not very far off. One rumour had it that they had occupied Dieppe, and it was very persistently held that a motor-car with German officers had actually reconnoitred Rouen itself. The fighting seemed close by when a British ambulance wagon from the front drifted into the hospital grounds, having lost all touch with its unit, and having travelled on till it found safety. The Royal Army Medical Corps corporal in charge was riding his officer's horse, but he knew nothing of the fate of the officer, or of his comrades. One man was driving the empty wagon, and the two horses—typical English farmyard "Dobbins"—were travel-stained and very weary. As this little group came slowly along the road, it reminded all who saw it of the picture, "The Remnant of an Army." Men and horses were taken in, fed and rested, and then sent down for embarkation.

No. 3 General Hospital arrived at Rouen at 11.30 p.m. on August 15, 1914, and established itself on the outskirts of the city, in the Maison de Repos, apparently a rest-house for Parisian midinettes. The building took about half the beds, while marquees were pitched in the ground to accommodate the remainder of them. The hospital was the first to arrive, and soon got busy, first with unfit reservists and then with wounded, the inflow being neutralized by an outflow to hospital ships and convalescent camps. As sixty beds had been ordered to be sent elsewhere, leaving 460 available, it was evident, in spite of commandeering the beds on the premises, that evacuation of cases would have to be carried out on a large scale, for casualties came along in great numbers and frequency. To do this, strict adherence to regulations and to preconceived ideas had to be flung aside, and things were done that would have made peace-time "red tape" weep.

At 11 p.m. on August 29, orders were received to move off at once all officer patients. There were thirty of them, and they were roused up and sent off to the river in tramway-cars. Next day no surprise was felt when, at 11 a.m., word was got to prepare to leave at very short notice, and packing up began at once. As the hospital had thought that it was a non-mobile unit, and was fixed "for the duration," there was some shortage of packing-cases, and of course it was impossible to re-bale the softer goods. There were also 240 patients still to be cared for and disposed of. Those that were quite unfit to travel were transferred to a French hospital, and all stretcher cases were moved out of the tents into the building. Fortu-

nately, the weather was fine—in fact, hot and sultry—so the lighter cases bivouacked under the numerous trees in the grounds while the marquees were being struck; but having to tend and feed all these men was not an aid to rapid packing. At 10 p.m. eight tramway cars arrived to move the remaining 230 patients. As the chances of seeing these vehicles again were not good, it was determined to clear the hospital in one journey, and strict orders were given that no car was to move without an order from the Commanding Officer in person. It was now pitch dark, but by the light of lanterns the cases were brought down and packed in. To fit them all into eight tramcars, along with an unloading party, took some doing. The stretchers were placed across the inside of the cars, with the handles resting on the window-sills and projecting, while some were fastened to the outside platforms. The sitting cases sat on the floors, under the stretchers, and men clung everywhere, inside and outside the cars, wherever a precarious foothold could be got. Every room in the hospital was then visited, every patient was seen to be out, and the word was given for the overloaded cars to start. They crawled off, black—or rather, khaki—with humanity, and by the mercy of Providence reached the hospital ship without accident. This was the "St. Andrew," one of the Fishguard-Rosslare boats, and was so crowded that No. 3 never saw its stretchers again, as they were all commandeered for beds.

After this, work was knocked off, as the night was very dark, and the men, who had worked hard and well, were very tired from their exertions of the day in the great heat—striking tents, packing, moving heavy equipment and shifting casualties.

Next day, August 31, packing continued, and was completed about 1 p.m. Blankets and sheets were tied up in bundles by the corners, while nails were brought out and boxes hurriedly fastened down. Orders were received to embark on the "Lord Charlemont," but there was no hint of urgency. The telephone was then cut off, without any previous intimation, and a good deal of time was wasted over it before this was found to be a permanent interruption. This was a severe blow, for the hospital was three miles from the town and quay, and, as the borrowed motor-car of an Englishman of Rouen had vanished, and the hospital horses had been ordered off early to another ship, communication with the quay and offices became difficult. In the morning the Commanding Officer went down by tram, and found that the ship was not yet in. On a second visit in the afternoon, he found it was still absent; but he was shown its berth, and an unloading party was posted there. About 5 p.m. the motor lorries arrived at the hospital, and loading up and removal of the equipment began at once. The Commanding Officer went down for the third time, in one of the lorries, and found that the ship had arrived, and that all the space near her was covered with the stuff of three other General Hospitals, which were in possession of the four derricks allotted to the loading of the vessel. Owing to the numerous railway lines on the quay, No. 3 had to dump its

stores about fifty yards from the ship. The captain said that he would sail at 10 o'clock next morning, unless forced to go sooner, and a visit to the town showed that all military offices were closing and clearing off. An atmosphere of urgency, that had not been noticeable before, seemed to have suddenly appeared, and on his way back to his unit the Commanding Officer found a general feeling of uneasiness about, and the air was full of rumours. By this time darkness had descended, and loading was carried on by the light of candle lanterns. The trees in the grounds interfered with the movements of the lorries, but the vehicles were filled up with rapidity. The men had heard the alarming rumours that were about, and were getting fidgety and apprehensive of missing the ship; but they worked with great energy, while the lorries went backwards and forwards at their utmost speed, for the drivers were becoming nervous and anxious to get away from Rouen. Towards the end, in the darkness, it was difficult to keep the men out of the lorries, and to make them collect the kits of the augmented party on the quay; but at last the loading up was concluded, and the Maison de Repos was abandoned. The Thresh disinfector collapsed about half a mile from the ship, and was abandoned, the nursing sisters having been sent off by train in the afternoon, and the horses were safely embarked on the "Teviot." The wheeled stretchers and diet carts were taken down by a walking party under the Adjutant, and the rest of the unit found room in the lorries. There was a general feeling of relief when the quay was reached and the ship was seen to be still there.

All this time nobody knew what had happened to the Army, but Amiens was said to be in flames and the enemy advancing; and the order that everybody was to sleep on the ship seemed ominous. There were mountains of equipment everywhere, belonging to four General Hospitals, and it looked to be more than the ship could hold. As the ship was prepared to sail at any moment, and as no derricks were available, it looked as if No. 3 was about to perish on the quay of Rouen, and its Senior Officers were exasperated. About 2 a.m., however (September 1), one derrick was secured, and a start was made with the most useful things, as the prospect of getting off everything seemed hopeless. Later on, however, a second derrick was obtained, and it was now determined to try and save everything. Most of the men were tired out and asleep on the ship; the temporary officers had also gone on board, as they were not needed at the time; the two regular captains did their best, but were very weary; and the occasion showed that middle age was not a spent force, for the situation was really saved by the three eldest men of the unit—the Commanding Officer, the second in command (Lieutenant-Colonel E. M. Morphew), and the quartermaster (Captain H. W. Glover). These three officers remained on the quay all night, never closed an eye, and were on their feet the whole time, driving and encouraging the working parties. Enough staunch men stuck to the work to keep the two derricks going, and at 5 a.m. all who had been asleep were roused as a relief. Later on, after a short rest, many of those who had worked all night

came on again, and after daylight was well on the scene was a very busy one. The mountains of equipment all around gradually lessened, and when all three derricks were got, and finally all four, the goods of No. 3 went into the ship at great speed, and to save it all became a race against time. The men streamed between the heap of equipment and the derricks like ants, carrying loads of all weights and sizes, while the wheeled stretchers rendered yeoman service. From 7 to 8 a.m. the Frenchmen working the cranes knocked off work, which was a great blow, but at 10.30 a.m. the last package went on board, leaving the regular officers just about "cooked," and many of the men run to a standstill. The feeling of triumph when the last lot went in was very great, while the embarkation officers marvelled and said they had thought it impossible for the quay to be cleared in the time. The mental strain of the anxiety of the fight against time to save the hospital, with the ever-present fear of the departure of the ship at any moment, was great, and the feeling of success was very soothing.

The weather all this time was very sultry, and the physical exertion in the great heat which all ranks had undergone since the order to pack up was received left everybody ready for a complete rest.

The ship sailed at noon, September 1, and speculation was rife as to whether the open sea would be reached, and Germans were looked for on every crest and ridge; but the enemy was not so near as was supposed, and by night the vessel was out of the river and safe.

To keep the equipment of each hospital completely separate in the holds was impossible, under the circumstances, but No. 3 lost nothing in the unloading at the new base.

September 2.—At sea. All hands resting. Visited by a French cruiser.

September 3.—Arrived at St. Nazaire in the afternoon, and anchored in the roads along with a number of other steamers. We could see thousands of our men bivouacking on the land and bathing in the sea. There were no tents at this time.

September 4.—Lay at anchor all day. In the evening a berth in the harbour became available, and the ship came alongside amid the acclamations of the populace. The A.D.M.S. came at once, and said he wanted a hospital ready by morning in a field a mile and a half away. As only one hour's unloading was done that night and no road transport was available, No. 3 regretted its inability to perform the impossible, but undertook to do its best to get something going next day.

September 5.—Derrick men appeared at 6 a.m., and unloading proceeded. Lieutenant-Colonel Morphew and a party were sent to the appointed field, next the Collège de Garçons, to prepare a hospital. The only transport available was six local carts, each drawn by one horse, unfit for military service, of slow speed, and requiring ample rest for meals. As the stores came out of the ship, the most essential articles were seized and sent up—such as tents, mattresses, blankets, drugs, etc.—but the unit sighed for the motor lorries of Rouen, with their ample space and speed.

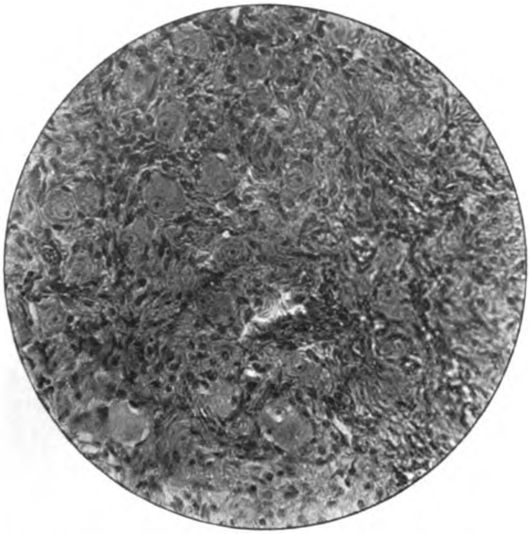


FIG. 1.—Photomicrograph of a sympathetic ganglion from a case of debility obtained one hour after death. The ganglion cells are turgid so that there are no gaps in the tissue. × 200.

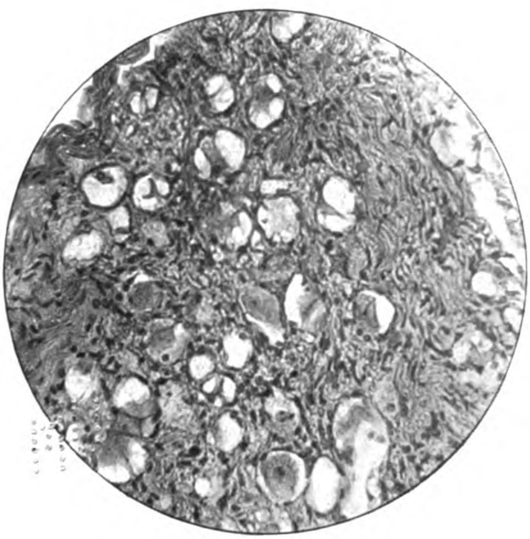


FIG. 2.—Photomicrograph of a sympathetic ganglion from a case of pellagra obtained twelve hours after death. Note the clear spaces left by the shrunken ganglion cells. × 200.

To illustrate Report of a Committee of Inquiry regarding the Prevalence of Pellagra among Turkish Prisoners of War.

The hospital ship "Astorias" was in harbour, and No. 3 was ordered to convey to her the British cases that were in a French hospital, but no extra transport was provided for the purpose. This felt like the last straw, but the work was done by sending the empty one-horse carts to the hospital on their return journeys, and by commandeering a non-military ambulance wagon that providentially turned up at the hospital conveying fresh cases. This digression, however, naturally interfered with the main work in hand, so the party in the field did splendidly when it took in a hundred patients that night.

September 6.—The ship was moved behind another one, so all unloading ceased. The *personnel* of No. 3, less a fatigue party for unloading, was moved up to the Collège de Garçons, and accommodated in two sheds. The unit was to take over this building, so it started getting it ready. It consisted mainly of class-rooms, with desks and benches screwed to the floor, which had to be unscrewed, and, along with much other material, stored in the sheds and attics. The tented hospital in the field alongside took in seventy-six cases in the morning. During the night a heavy thunderstorm occurred, with torrents of drenching rain, and an A.S.C. officer came and begged shelter for his men, who were in the open entirely unprotected. They were allowed into some of the marquees, where they fitted closely but were very grateful.

September 7.—Ship got alongside the quay again, and unloading resumed. The unit was simultaneously unloading the ship and sending up the equipment one and a half miles, preparing the building as a hospital, pitching marquees in the grounds, and receiving, treating and discharging large numbers of cases in the tented hospital in the field.

September 8.—All this time the nursing sisters were at Pornichet, about four miles off, and some of them were now sent for. Constant arrivals and evacuations of sick and wounded going on.

September 9, 10 and 11 were repetitions of the struggle to get up the stores from the ship, equip beds in the building and marquees, and deal with the large number of patients that were coming and going. On the 11th all the equipment had come up, all beds were ready, and the field was handed over to a stationary hospital, while No. 3 went into the building and its grounds.

This ended a period of great effort and difficulty, and the hospital then became so inundated with casualties that it was practically a casualty clearing station. It was the only hospital at St. Nazaire that had a building, and so the bulk of the work fell upon it, as it had facilities denied to the others. From first to last it never refused to take in a case from anywhere or anybody, and always had room for "just one more."

STUDIES ON THE WEIL-FELIX SEROLOGICAL TEST FOR THE LABORATORY DIAGNOSIS OF TYPHUS FEVER.

By Captain ARTHUR COMPTON.

Towards the close of 1918 and the beginning of 1919, during the typhus season in Syria, I had an opportunity of carrying out a number of blood tests on cases of acute typhus, from the point of view of the Weil-Felix reaction recently described in connexion with this disease.[1] The reaction, be it recalled, is an expression of the power often possessed, and developed during the disease, by the blood serum of the typhus patient, of specifically agglutinating *in vitro* a bacterial emulsion of *Bacillus proteus* *X*19. Although the studies with which this paper deals, make no pretence at being exhaustive—which they could scarcely be, considering the "field conditions" under which they were carried out—still, in the confirmation which they afford of the constancy of the reaction in the disease, a short account of them may prove instructive. The contribution is merely a pioneer one.

Clinical Material.

Forty-seven blood tests were in all performed on some fourteen cases (British, Indian and Turkish prisoners of war) of the disease; the tests ranging from the fourth to the thirty-fourth day of illness, and consequently covering the various stages of the disease from onset to convalescence.

To Captain William Forsyth, R.A.M.C., and to Captain K. B. Dickson, R.A.M.C., under whose clinical care these cases were, my best thanks are due, for placing them at my disposal for the benefit of this investigation.

Technique.

Blood from the patient's thumb was collected in a Wright's blood tube, and on arrival at the laboratory was centrifuged to separate off the serum. The agglutination titre of the latter was then determined towards a ten to twelve thousand bacterial emulsion of *B. proteus* *X*19 in saline phenolated to 0·5 per cent. The slide method of macroscopic agglutination associated with the names of Alcock[2] and Garrow[3] was employed, the results being read off after three minutes' rotation of the slide in the agglutination box.

Experimental Findings.

The following table briefly summarizes the main features of the cases and the results of the blood tests performed.

[1] E. Weil and A. Felix: *Wien. klin. Woch.*, xxi (No. 2), 1916, 33 to 35.

[2] Broughton Alcock: Journal of the Royal Army Medical Corps, xxx, 1918, 424-431.

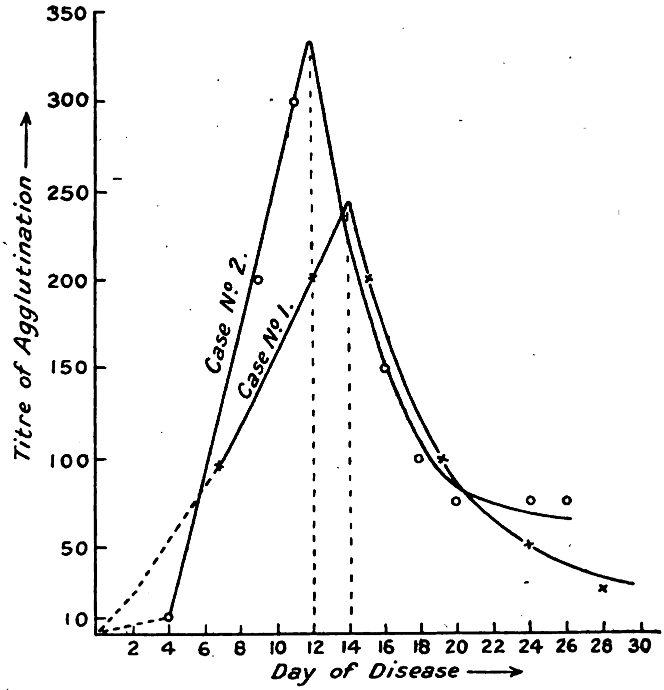
[3] R. P. Garrow: *Lancet*, i, 1917, 262: Journal of the Royal Army Medical Corps, xxviii.

TABLE.

No. of case	Name	Nationality	Date of blood specimen	Whether rash present or absent	Day of illness (patient's statement)	Result of the agglutination test, for the following dilutions of the patient's serum							Date the patient's temperature fell to normal
						1/2	1/10	1/50	1/100	1/200	1/400	Saliva continued	
1	S. ..	British	1.1.19	Present	7	++	++	++	+	−	−	−	5.1.19
			5.1.19	..	12	++	++	++	++	+	−	−	..
			8.1.19	..	15	++	++	++	++	+	−	−	..
			12.1.19	..	19	++	++	++	+	(+)	−	−	..
			17.1.19	..	24	++	++	+	−	−	−	−	..
			21.1.19	..	28	++	++	(+)	−	−	−	−	..
			27.1.19	..	34	++	++	(+)	−	−	−	−	..
2	R. ..	British	5.1,19	Present	4	++	+	−	−	−	−	−	12.1.19
			8.1.19	..	7	++	++	++	+	(+)	−	−	..
			10.1.19	..	9	++	++	++	++	+	−	−	..
			12.1.19	..	11	++	++	++	++	+	(+)	−	..
			17.1.19	..	16	++	++	++	++	(+)	−	−	..
			19.1.19	..	18	++	++	++	+	(+)	−	−	..
			21.1.19	..	20	++	++	++	(+)	−	−	−	..
			25.1.19	..	24	++	++	++	(+)	−	−	−	..
			27.1.19	..	26	++	++	++	(+)	−	−	−	..
3	H. ..	British	8.1.19	Present	7	−	−	−	−	−	−	−	17.1.19
			10.1.19	..	9	−	−	−	−	−	−	−	...
			12.1.19	..	11	−	−	−	−	−	−	−	..
			17.1.19	..	16	++	−	−	−	−	−	−	..
			19.1.19	..	18	++	+	−	−	−	−	−	..
			22.1.19	..	21	+	−	−	−	−	−	−	..
			27.1.19	..	26	+	−	−	−	−	−	−	..
4	Capt. B.	British	9.1.19	Absent	4	+	−	−	−	−	−	−	..
			10.1.19	Present	5	++	+	−	−	−	−	−	..
			12.1.19	..	8	++	++	−	−	−	−	−	..
5	S. R...	Turkish	10.1.19	Present	5	++	−	−	−	−	−	−	19.1.19
		P. of W.	15.1.19	..	10	++	++	(+)	−	−	−	−	..
			23.1.19	..	14	++	++	−	−	−	−	−	..
6	M. A...	Turkish	10.1.19	Absent	4	++	++	−	−	−	−	−	19.1.19
		P. of W.	15.1.19	Present	9	++	(+)	−	−	−	−	−	..
			23.1.19	..	17	++	−	−	−	−	−	−	..
7	A. S...	Turkish	10.1.19	Absent	4	++	++	−	−	−	−	−	21.1.19
		P. of W.	15.1.19	Present	9	++	++	++	++	−	−	−	..
			23.1.19	..	17	++	++	+	−	−	−	−	..
8	M. ..	British	23.1.19	..	5	++	+	−	−	−	−	−	..
			25.1.19	..	7	++	++	(+)	−	−	−	−	..
			27.1.19	..	9	++	++	+	−	−	−	−	..
9	O.M.A.	Turkish	10.1.19	..	10	++	++	++	+	(+)	−	−	15.1.19
		P. of W.	23.1.19	...	23	++	++	(+)	−	−	−	−	..
10	Y. S...	Turkish	10.1.19	Fading	12	++	++	+	(+)	−	−	−	21.1.19
		P. of W.	23.1.19	..	25	++	+	−	−	−	−	−	..
11	M. H.	Turkish	10.1.19	Present	5	++	++	(+)	−	−	−	−	22.1.19
		P. of W.	23.1.19	..	18	++	++	−	−	−	−	−	..
12	K. S...	Indian	11.1.19	..	9	++	++	++	+	−	−	−	11.1.19
13	R. R...	Indian	12.1.19	Present	9	++	+	−	−	−	−	−	..
14	Y. M...	Turkish P. of W.	15.1.19	Present 4 days	6	++	++	+	−	−	−	−	..

++ = agglutination very marked.
\+ = ,, distinct to naked eye.
(+) = ,, feeble, requiring hand lens to be certain.
− = ,, negative.

The above table (columns 6 and 7) shows that these cases all, with the exception of Case 3, gave a markedly positive reaction from the first days of the disease; and that the strength of the reaction varied from day to day. Some idea of the nature of this variation is revealed by the accompanying diagram, which is a graphical representation of the findings for Cases 1 and 2.



These curves show that the Weil-Felix reaction in typhus fever steadily increases during the first fortnight to attain its maximum about the twelfth to fourteenth day of the disease-period, when, in the uncomplicated case, the temperature as a rule falls by crisis—to decrease rapidly thereafter during the period of convalescence. This finding indicates, other things being equal, wherein as a test the Weil-Felix reaction may render conspicuous service to the physician. It points to the conclusion that in an early case of doubtful pyrexia, which shows a positive Weil-Felix reaction steadily rising in the twenty-four hours, there is strong presumptive evidence of typhus fever.

Consider now Case 3, which appeared to us at first in the light of an exception (see tests of January 8, 10, and 12) to the test; there being no doubt clinically as to the diagnosis of typhus. This man's Weil-Felix reaction was persistently negative throughout the first fortnight, to become positive about the sixteenth day of the disease—when it was first observed—

his blood having then acquired the power to agglutinate markedly *B. proteus* X19 in a serum dilution of $\frac{1}{2}$, but not beyond. On the sixteenth day his temperature fell by crisis. A blood test forty-eight hours later revealed that the titre of agglutination, although still low, had increased slightly, being again well marked in the $\frac{1}{2}$ dilution and feebly so in the $\frac{1}{10}$ dilution. Thereafter in his case, as for the others, this feebly positive Weil-Felix reaction—which might well have been missed, on the method employed, had it not been studied persistently and that in very low dilutions—its maximum having been reached, fell gradually off.

Of the fourteen cases, then, of typhus tested by us: thirteen (or ninety-three per cent) showed well-marked Weil-Felix reactions, and one (or seven per cent) gave such a feeble reaction that it might well have passed unperceived and been returned as negative. The percentage figures here have little value, the number of cases examined being so small.

The significance of positive Weil-Felix reactions, other than the practical one that they may be utilized as a laboratory method for the diagnosis of typhus, is unknown.[1] As to that of such feebly positive reactions as the one above described—for no truly negative Weil-Felix reaction has been met with in any case of typhus examined by me—it may be that such reactions are to be correlated with the curious phenomenon, recently described by Nicolle and Lebailly,[2] of "inapparent infection." In the latter phenomenon, observed so far only in laboratory animals and that in connexion with experimental typhus, a guinea-pig occasionally shows no temperature reaction, following inoculation with the virus of typhus; and yet its blood, at the time when the control animals show well-marked fever, is found to be virulent, especially for the African monkey. Rats, again, do not ordinarily react by even an elevation of temperature to the virus of typhus; but their blood is virulent about the twelfth day.

These, then, are some at least of the interesting problems connected with this disease which it is for future investigation to solve.

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[1] C. Craig and H. Fairley (*Lancet*, September 28, 1918, p. 886) view the Weil-Felix phenomenon in the light of a group agglutination; the virus of typhus being probably an organism allied to *B. proteus* X19, but resistant to cultivation on ordinary media.

[2] Ch. Nicolle and Ch. Lebailly. *Comptes rendus*, 1919, clxviii, p. 800.

Clinical and other Notes.

A METHOD OF LOADING THE EQUIPMENT OF A FIELD AMBULANCE, AS PRACTISED IN THE FIELD.

By Lieutenant-Colonel W. I. THOMPSON.
Royal Army Medical Corps.
Officer Commanding 65th Field Ambulance.

Preliminary Note.

The following method of loading the G.S. and limbered wagons of a field ambulance which is liable to be constantly on the move, has been evolved principally from the point of view of utility, but also from the fact that, from a practical point of view, the sectional method of loading, in three pairs of wagons with similar loads, leads to an unnecessary splitting up of the ambulance equipment.

The independent movement of sections with their transport has been conspicuously absent on the Western Front.

The terms "medical store" and "baggage" wagon have been dispensed with and the G.S. wagons designated by numbers, i.e., Nos. 1 to 6.

A similar enumeration has been adopted in the case of the limbered wagons, i.e., Nos. 1, 2, 3, and "cooks'." Incidentally, I happen to be my own transport officer, and the question of "loads" is one very near my heart.

I wish to emphasize the fact that this method is not a mere theoretical one, but has been carried out for the past twelve months in this unit and has proved its efficiency.

With regard to the six horsed ambulance wagons there are one or two modifications which I will mention here, and which are as follows:—

On "A" section wagon, one spare forewheel for ambulance wagon Mark vi is carried in the luggage-carrier on the roof.

Twelve instead of eight blankets are also carried in this wagon.

On "B" section wagon, one spare forewheel for a G.S. wagon is carried in the luggage-carrier, and ten blankets.

A similar number of blankets are carried in "C" section wagon, but no spare wheel.

A medical companion and water-bottle are carried in each of the three wagons.

The reason for carrying the extra blankets, four in the case of "A," and two each in the case of "B" and "C" wagons, is to effect a more reasonable distribution in the two "Ford" cars, i.e., four in each instead of eight.

The blankets of the A.S.C. (M.T.) personnel (i.e., 13), are carried in the cars, and used as cushions for the drivers to sit on.

Any critical investigation will discover numerous, actual, or apparent, deficiencies of individual items, for example: (*a*) eighteen only instead of twenty-one ordnance panniers are shown as carried in G.S. wagon No. 2, the reason being that the contents of the three "G" panniers have been absorbed into the others; (*b*) pyjama suits sixty, and aprons, operating, eighteen, do not appear by

name but are actually carried in the "B" panniers, and many other instances might be given.

It will be noted that two field fracture boxes, two reserve medical panniers, and one reserve dressing box, do not appear on any of the wagons.

It has been found that these, with other articles (i.e., a pair of field medical and a pair of field surgical panniers), can quite easily be dispensed with, and accordingly they were returned to the nearest advanced depot of medical stores.

Surplus forage (if any) is carried on the Maltese cart.

G.S. wagon No. 6 is allotted for quartermaster's stores (rations, clothing, medical comforts, etc.).

The horsed ambulance wagons are invariably kept empty, as usually on the move the unit is attached to a brigade, and these wagons follow the infantry battalions.

I am very much indebted to my Regimental Serjeant-Major R. R. Parry, for his supervision of the loading, and for working out the weights for each vehicle, and to Lieutenant and Quartermaster W. H. Emblem, for his expert advice.

WAGON LOADS—G.S. No. 1.

Articles	Number	Approximate weight
Field medical panniers	4	296 lb.
Field surgical panniers	5	435 ,,
Reserve dressing boxes	5	235 ,,
Stretchers (less slings and pillows)	36	1,008 ,,
	Total	1,974 lb.

WAGON LOADS—G.S. No. 2.

Articles	Number	Approximate weight
Panniers (A-F)	18	1,620 lb.
Pillows, stretcher	36	72 ,,
Slings, stretcher	72	
Pannier, medical comfort	1	90 ,,
Tables, operating	2	46 ,,
Mattresses, operating table and securing strap	2	26 ,,
	Total	1,854 lb.

WAGON LOADS—G.S. No. 3.

Articles	Number	Approximate weight
Wheel, spare, G.S., hind	1	168 lb.
Wheel, spare, Amb. Mk. vi, hind	1	170 ,,
Pole, draught, No. 7A	1	38 ,,
Poles, draught, No. 17A	2	80 ,,
Shaft, draught, Maltese cart	1	88 ,,
Lamps, operating, F.A. Mk. iii	3	195 ,,
Boxes, lantern, distinguishing, double	3	42 ,,
Panniers, G.S. (materials for repair of harness)	2	112 ,,
Sheets, ground	120	300 ,,
Poles, flag, pendant	6	12 ,,
Stoves, portable	3	260 ,,
Baggage, officers'	..	? 600 ,,
	Total	2,025 lb.

Wagon Loads—G.S. No. 4.

Articles	Number		Approximate weight
Blankets, G.S. (equipment)	130	..	585 lb.
Blankets. G.S. (personnel includes thirty-six A.S.C., H.T.)	218	..	981 ,,
Cases, bolster	150	..	150 ,,
Carriers, stretchers, wheeled, Miller-James ..	2	..	170 ,,
	Total	..	1,886 lb.

Wagon Loads—G.S. No. 5.

Articles	Number		Approximate weight
Tents, operating	2	..	362 lb.
Tents, C.S.L.	12	..	999 ,,
Poles, flag, distinguishing	3	..	183 ,,
Cases, paillasse..	90	..	270 ,,
Carrier, stretcher, wheeled, Miller-James	2	..	170 ,,
	Total	..	1,984 lb.

Wagon Loads—Limber No. 1.

Articles	Number		Approximate weight
Field medical panniers	2	..	48 lb.
Field surgical panniers	1 (No. 1)		87 ,,
Medical comfort panniers	1	..	90 ,,
Dressing boxes	3	..	60 ,,
Field fracture box	1	..	82 ,,
Table, operating, in case	1	..	82 ,,
Medical companions and water bottles	3	..	44 ,,
Surgical haversacks and water bottles	21	..	194 ,,
Shell dressing haversacks	18	..	90 ,,
Blankets, G.S.	50	..	225 ,,
Tent, operating	1	..	181 ,,
Table, camp, folding	1	..	14 ,,
Stool, camp, folding	1	..	7 ,,
Poles, flag, pendant	6	..	12 ,,
	Total	..	1,316 lb.

Wagon Loads—Limber No. 2.

Articles	Number		Approximate weight
Panniers "H"	3	..	270 lb.
Panniers, medical comfort	4	..	360 ,,
Tables, folding camp	2	..	28 ,,
Stools, folding camp	2	..	14 ,,
Bags, tool, shoemakers' (filled)	3	..	78 ,,
Tools, entrenching (spades, picks, axes)	sets 3	..	276 ,,
Tools, carpenters (in box)	sets 3	..	90 ,,
	Total	..	1,116 lb.

Wagon Loads—Limber No. 3.

Articles	Number		Approximate weight
Orderly room equipment	—	..	500 lb.
Sheets, ground	60	..	150 ;,
Stools, close, nests	6	..	174 ,,
Carriers, stretcher, wheeled, Miller-James ..	2	..	170 ,,
	Total	..	994 lb.

WAGON LOADS—COOKS' LIMBER.

Articles	Number		Approximate weight
Kettles, camp	20	..	340 lb.
Balances, spring	2	..	18 ,,
Implements, butchers'	sets 3	..	111 ,,
Rations	—	..	500 ,,
	Total	..	969 lb.

WAGON LOADS—MALTESE CART.

Articles	Number		Approximate weight
Chests, tool, filled, farrier's	1	..	112 lb.
Anvils..	1	..	112 ,,
Blocks, anvil	1	..	112 ,,
Jacks, lifting, G.S.	1	..	38 ,,
Chests, veterinary	1	..	20 ,,
Wallets, veterinary	1	..	7 ,,
Bags, tool, filled, farrier's	1	..	14 ,,
Shoes, horse and mule, boxes	2	..	160 ,,
Picketing gear	various	..	56 ,,
Forage, spare harness, etc.	,,	..	400 ,,
	Total	..	1,028 lb.

THE INTRAVENOUS INJECTION OF EUSOL IN SUBTERTIAN MALARIA.

By LIEUTENANT-COLONEL P. S. VICKERMAN.
Royal Army Medical Corps.

THE intravenous injection of eusol in cases of septicæmia suggested to me its possible value in treating sub-tertian malaria. I think the following cases carefully checked microscopically by Captains P. H. Bahr and A. D. Bigland, R.A.M.C., will speak for themselves as to the efficacy of the treatment.

Some cases have been cured by one injection, others have needed two, or even three; in none of these cases has quinine been used while under treatment with eusol, nor have they needed it afterwards. The number of injections has no seeming relation to the number of rings and crescents found. The crescents seem to disappear first and the rings rather later.

The strength of the eusol is very important, the most satisfactory results I have obtained have been with the "Eupad" prepared at the Edinburgh University and sent out in stoppered bottles. Eusol made with the chloride of lime obtained in the field, which is often below strength in chlorine, has given varying results accordingly. Captain J. K. Lund, R.A.M.C.(T.) has, however, supplied a simple, rapid and efficient test for calculating if the strength of hypochlorous acid in the solution is up to normal, *vide* under.

The technique of giving eusol intravenously is very simple. Through an ordinary intravenous saline apparatus, filling the funnel and tube first with saline when introducing the needle into the vein, forty cubic centimetres of freshly-prepared and well-filtered eusol is run in. Sufficient normal saline is afterwards poured into the funnel to ensure all the eusol entering into the vein. In a case of malaria a typical "fever attack" follows on the same day with rigor, then the

temperature settles down practically at once, although the organisms do not all disappear from the blood till sometimes ten days after. In the meantime the patient feels well and has no fever attacks.

Another type of malarial case I have found eusol very efficacious in has been the old chronic type with large spleen and marked malarial cachexia and anæmia, often showing very few or no parasites in the blood microscopically. The maximum dose I consider to be given with absolute safety is sixty cubic centimetres. I have seen one case of septicæmia receive 100 cubic centimetres, which caused immediate jaundice and suppression of urine, although he recovered after two days and was very much better ultimately.

Pathological Report on Eusol Cases.

Based upon (1) finding malarial parasites in blood; (2) differential blood count.

N.B.—"Negative" results, twenty minutes search. Differential counts, 300 white cells counted.

Case 1.—December 7, 1916: Many crescents and few subtertian rings found. 10th: Eusol injected, 40 cubic centimetres intravenously. 13th: Hæmoglobin, 70 per cent; red blood corpuscles, 2,800,000; white blood corpuscles, 5,200; index, $1\frac{1}{8}$; polymorphonuclears, 48 per cent, lymphocytes, 40 per cent; mononuclears, 12 per cent; eosinophil, 0 per cent; few nucleated reds, poikilocytosis. 16th: No malarial parasites found. 19th: Numerous subtertian rings, no crescents. 28th: Hæmoglobin, 70 per cent; red blood corpuscles, 2,400,000; white blood corpuscles, 4,600; index, $1\frac{3}{8}$; polymorphonuclears, 53 per cent; lymphocytes, 33 per cent; mononuclears, 13 per cent; eosinophil, 1 per cent. January 14, 1917: No crescents or rings found. 17th: No malarial parasites found (confirmed, P. H. Bahr). 19th: Polymorphonuclears, 53 per cent; lymphocytes, 36 per cent; mononuclears, 7 per cent; eosinophils, 4 per cent (300 cells counted), (confirmed, P. H. Bahr).

Case 2.—January 5, 1917: Subtertian rings and crescents found. 7th: Eusol 40 cubic centimetres intravenously. 17th: No rings or crescents. 20th: Polymorphonuclears, 47 per cent; lymphocytes, 47 per cent; mononuclears, 5 per cent; eosinophils, 1 per cent.

Case 3.—December 8, 1916: No malarial parasites found. 22nd: Clinical indication of malaria present. 29th: 40 cubic centimetres intravenously. January 5, 1917: Subtertian rings found. 7th: 40 cubic centimetres intravenously, eusol. 16th: No crescents or rings found. 18th: No crescents or rings found. 20th: Polymorphonuclears, 60 per cent; lymphocytes, 33 per cent; mononuclears, 6 per cent; eosinophils, 1 per cent.

Case 4.—November 13, 1916: Large numbers of crescents and some rings found in blood on many occasions was confirmed. Flagellated body formation noted. 19th: Large numbers of crescents present. December 1, 1916: White count 3,432; crescents 624 per cubic centimetre. 5th: Eusol 40 cubic centimetres intravenously. 8th: Two crescents found after seven minutes search. 19th: Subtertian rings found, no crescents. 29th: No rings or crescents found. January 20, 1917: No rings or crescents found.

Case 5.—January 13, 1917: Subtertian rings and crescents. 14th: Eusol

40 cubic centimetres intravenously. 18th: Subtertian rings and crescents present (three crescents found in ten minutes). 20th: (Just before operation) no subtertian rings seen; crescents still present. 23rd: Eusol 40 cubic centimetres injected. 26th: No rings or crescents found. February 13: Subtertian rings and crescents present. March 1: 100 cubic centimetres eusol (local manufacture and weak). 28th: No malarial parasites present. April 12: No parasites; polymorphonuclears, 69 per cent; lymphocytes, 24 per cent; mononuclears, 4 per cent; eosinophils, 3 per cent.

Case 6.—February 17, 1917: Subtertian rings found. 19th: Eusol 40 cubic centimetres intravenously. March 5: No malarial parasites found. May 25: No malarial parasites found.

Case 7.—January 5, 1917: Subtertian rings and crescents found. 7th: Eusol 40 cubic centimetres intravenously. 15th: No malarial parasites found. March 15: No malarial parasites found.

Case 8. *History of Malaria with Anæmia and Cachexia.*—January 1, 1917: No parasites. Hæmoglobin, 60 per cent; red blood corpuscles, 1,700,000; white blood corpuscles, 7,000; index 2; polymorphonuclears, 38 per cent; lymphocytes, 48 per cent; mononuclears, 13 per cent; eosinophils, 1 per cent. 16th: No nucleated reds seen; malarial temperature. 17th: 40 cubic centimetres eusol intravenously. 23rd: No temperature since eusol; lost cachexia; colour in cheeks; gets up all day. 29th: No temperature since eusol. "A new man," full of vigour. February 4: Discharged hospital. Anæmia disappeared and full of vigour.

Case 9.—December 6, 1916: A markedly cachectic and anæmic patient, with a history of malaria with enlarged spleen and œdema of legs. January 25, 1917: After running an irregular temperature, to-day had a rigor with temperature 104·2° F. 26th: No malarial parasites found. 27th: 40 cubic centimetres eusol intravenously. February 1: Better; no malarial parasites; polymorphonuclears, 61 per cent; lymphocytes, 8 per cent; mononuclears, 29 per cent; eosinophils, 2 per cent. 16th: Patient much improved; no œdema. March 16: Patient up, spleen not palpable. April 2: Discharged fit.

Case 10.—A markedly cachectic and anæmic patient with history of malaria and enlarged spleen. June 6, 1917: No malarial parasites but poikilocytosis and polychromatophilia. During June tried with quinine hydrochloride with no effect on condition; temperature irregular. 27th: Hæmoglobin, 50 per cent; red blood corpuscles, 1,040,000; white blood corpuscles, 3,000; polymorphonuclears, 50 per cent; lymphocytes, 40 per cent: mononuclears, 4 per cent; eosinophils, 1 per cent; no parasites. July 5: 40 cubic centimetres eusol intravenously. August 9: Hæmoglobin, 60 per cent; red blood corpuscles, 3,000,000; white blood corpuscles, 3,500; index, 1; polymorphonuclears, 47 per cent; lymphocytes, 45 per cent; mononuclears, 7 per cent; eosinophils, 1 per cent. September 15: Hæmoglobin, 80 per cent; red blood corpuscles, 4,000,000; white blood corpuscles, 8,000; polymorphonuclears, 57 per cent; lymphocytes, 34 per cent; mononuclears, 5 per cent; eosinophils, 2 per cent. 30th: Discharged fit.

It will be obvious in the intravenous injection of eusol, apart from correct technique, that the eusol itself should be of the requisite purity and strength. The former can be assured by using boiled, filtered or distilled water in its manu-

facture. It should invariably be freshly made, but if it is desired to keep it a short period for the treatment of septic wounds, as laid down in the Circular issued by the D.M.S., General Headquarters, Egyptian Expeditionary Force, it should be kept in dark brown (non-actinic) stoppered bottles, which should be completely filled with the eusol, thereby preventing oxidization by air.

It is essential that eusol should contain at least 5 per cent of available hypochlorous acid, and providing that the eusol is made according to the prescribed method, and that the bleaching powder is of good quality (not less than 22 per cent of free chlorine), the eusol should be of the requisite strength, but it loses considerably during the first twenty-four hours. The quantitative estimation of chlorine in bleaching powder is a laboratory operation, and even then does not guarantee the strength of the final product.

The following test for eusol, kindly worked out by A. Lucas, Esq., F.I.C. (Egyptian Government Analyst), is calculated to meet all necessary requirements. No special apparatus is needed, a fact which will commend the test for rapid work in hospital or the field.

Apparatus required.—A bottle containing eusol-testing solution, test papers, and a measure glass or similar vessel.

Eusol-testing Solution.

Arsenious oxide	3·86 grm.
Sodium bicarbonate	15·6 ,,
Water	1,000 c.c. (= 1 litre).

Test Paper.—Unglazed white paper is soaked in the following solution, dried, and cut into strips:—

Potassium iodide	0·1 grm.
Starch	1 ,,
Water	100 c.c.

The paper should be dried at a temperature of 40° to 50° C.

To test.—To Eusol add slowly, with constant stirring, an equal volume of eusol testing solution. A slight cloudy precipitate will form, which disappears on stirring. Moisten a piece of dry test paper. Dip a pencil or glass rod in the mixture, and lightly touch the test paper. If the eusol is 0·5 per cent in strength or over, a blue colouration will be produced on the test paper. No colouration will be produced if the eusol is under 0·5 per cent.

PROPHYLACTIC OR TEMPORARY CÆCOSTOMY IN RESECTION OF THE DISTAL PORTION OF THE COLON FOR NON-OBSTRUCTIVE CONDITIONS.

By Major GORDON TAYLOR.
Royal Army Medical Corps.

The following brief note has been written with the object of drawing attention to a little surgical manœuvre, which has been of service to me in cases of resection of portions of the distal half of the large intestine. This step in the surgical technique of excision of any portion of the large bowel between the splenic flexure and the sigmoid colon I learnt in the course of conversation with a very distinguished Scottish surgeon who employed it, but in France I have met with

very few surgeons who appeared to be familiar with the procedure, either in theory or in practice. It is of course established now that excision of portions of the large intestine for gunshot injury in the "forward area" is only rarely indicated, and indeed, in the few papers upon gunshot wounds of the abdomen which have been sent to me by my surgical friends or to which I happen at present to have access, there is scarcely any record of resections of the large bowel, and hardly a note of a successful case.

(*a*) I have employed temporary cæcostomy in the United Kingdom in cases of resection of the large intestine for carcinoma originating in any part from the splenic flexure to the pelvic colon. I am not referring to cases of intestinal obstruction above an operable cancerous growth, where of course the obstruction must be relieved by operation before any idea be entertained of extirpating the tumour, but I am advocating temporary or provisional cæcostomy in cases of excision of a carcinomatous splenic flexure, descending, iliac or pelvic colon, where no obstruction exists. The opening acts as a vent for gases generated in the colon above and near the suture line, and acts as a safety valve in preventing any strain on the junction.

I am aware of the brilliant results obtained in excisions of cancerous segments of the large lower bowel by distinguished operators, but I submit that this little point of technique may be of value to surgeons of ordinary dexterity; it has certainly added to my mental comfort in the treatment of these cases, and it has as certainly promoted the convalescence of the patients.

(*b*) I have also on several occasions made use of temporary cæcostomy when operating in the United Kingdom to close a proximal inguinal colostomy performed in France for some severe gunshot injury of the rectum. Opinion is not yet finally settled as to the best means of closing an inguinal colostomy, but I have personally usually performed an intraperitoneal operation, excising the "spur" and practising end-to-end union of the bowel. In such cases as in those of excision of a carcinoma, I have found temporary cæcostomy to be a measure of safety. It might appear to be a retrograde step to substitute a stoma in the right iliac fossa for one of the left side, but if the cæcum is simply anchored to the parietal peritoneum, the opening closes readily enough, especially if the drainage tube in the cæcum be inserted after the manner of a Senn's gastrostomy. I have never had to undertake any operation to close a cæcostomy performed in this way, and the stoma generally closes in ten days to a fortnight.

(*c*) Excisions of portions of the distal colon for gunshot injury. It is an axiom of military surgery that in the cases of gunshot wounds of the bowel the least possible should be done, and that suture should be preferred to resection, unless the latter is inevitable. The whole experience of the surgery of this war has demonstrated that suture suffices in the large majority of cases of injury to the colon; by reason of the size of this portion of the intestinal tract, its wounds are mostly of the nature of perforations or tears, and the bowel is rarely completely divided. Moreover the absence of numerous loops and coils makes multiplicity of wounds of the colon uncommon, when compared with their frequency in the small intestine. Nevertheless I do claim that there are certain cases of gunshot injury of the large intestine where a resection of the damaged portion is indicated, more especially when infarction of the bowel is present. Further, in some cases where the wound of the large intestine has been of such magnitude or difficulty

of approach as to suggest the formation of an artificial anus, recourse might well be made to excision and suture when the high mortality of the colon anus is borne in mind. The adoption of this procedure would of course be influenced by the general condition of the patient.

If excision is to be practised, let the removal be free, and let the bowel sections be planned in accordance with the dictates of general surgical experience. The wide removal of damaged bowel and of the adjacent damaged and devitalized retroperitoneal tissue which the resection facilitates finds justification not only in being in keeping with the ordinary rules for treatment of gunshot wounds by excision of the damaged area, but also by the end results in those cases in which this more drastic operation has been undertaken. With few exceptions, these have all been cases of gunshot injury to the distal portion of the large intestine, and in these the temporary or provisional cæcostomy performed at the time of resection has proved to be a measure of safety. The opening has been made into the cæcum at the end of the operation, while the sister is suturing the skin of the laparotomy incision. The "gridiron" method affords convenient access to the cæcum, and the drainage tube is inserted like a Senn's gastrostomy. If a collodion or mastisol dressing be applied to the laparotomy wound, there does not appear to be any extraordinary risk of infection of the latter.

Case 1.—Penetrating wound of abdomen, severe wound of cæcum and ascending colon; excision of cæcum, ascending colon and hepatic flexure; end-to-side union of ileum and transverse colon; suture of jejunum.

Private J. K., of the 1st Buffs, was admitted on November 20th, 1917, into a casualty clearing station with two penetrating wounds of the abdomen. Two fragments of shell had entered the abdominal cavity through the right flank, and the cæcum and ascending colon were both badly damaged and perforated, the latter being almost completely divided. There were four wounds of the jejunum, which were sutured. Operation was performed about ten hours after the man was hit, and at the time he was in rather poor condition. The wounds in the flank were widely excised and subsequently vigorously treated by "Carrel's" method: the terminal part of the ileum, the cæcum, ascending colon and hepatic flexure were excised, and an end-to-side junction performed between ileum and the transverse colon. The patient made a good recovery and was evacuated to the base, and I last heard of him in an unsolicited letter from the medical officer in charge of a Red Cross hospital in the South of England, telling me of the patient's complete recovery and congratulating me on the successful case.

Case. 2.—Penetrating wound of the abdomen; resection of jejunum; end-to-end union; resection of distal part of transverse colon, splenic flexure and descending colon; end-to-end union; cæcostomy.

Lance-Corporal W., of the M.G.C., was admitted into a casualty clearing station in the early hours of a February morning with a penetrating wound of the abdomen, produced by a shell fragment. The piece of shell entered the left flank, completely dividing his descending colon, and shattering its adjacent edges. The upper jejunum was the site of several large perforations, and its mesentery was perforated and bleeding; three feet of jejunum were resected and an end-to-end junction performed. The missile had made a large rent on the posterior aspect of his transverse colon, and passing forwards and to the right half just penetrated the anterior surface of this portion of the bowel. It was deemed safer to excise the

damaged portion of the transverse colon, splenic flexure, descending and iliac colon, and an end-to-end junction was performed between the proximal portion of the transverse colon and the splenic flexure. The wound of entry was excised widely and "Carreled"; a temporary cæcostomy was then performed. Apart from passive collapse of the lower lobe of his left lung and some trouble with the laparotomy wound, the patient made a good recovery, and was evacuated to the base a month later and subsequently to England.

Case 3.—Private G. W., of the T.M.B., was admitted into a casualty clearing station in the early hours of a Jannary morning with a penetrating wound of the abdomen, due to a fragment of shell. After the patient had been warmed and resuscitated for a couple of hours, the abdomen was opened, and nine or ten perforations of the jejunum were sutured, and in addition a resection of eighteen inches of small intestine lower down was performed. Four wounds of the sigmoid were found, two of which were on the mesenteric border; as the bowel was in a state of infarction, the damaged portion was resected, and an end-to-end junction made. The foreign body was removed from the musculature of the left flank, and the damaged tissues widely excised; a temporary cæcostomy was performed. The patient's recovery was uneventful. the cæcostomy closed after ten days, by which time the rectum was acting satisfactorily, and he was evacuated to the base in three weeks, and subsequently went to England. Curiously enough this patient's father had undergone an abdominal operation at my hands in Middlesex Hospital some few years ago.

Case 4.—Penetrating wound of the abdomen; large tear of the iliac colon, limited resection, temporary cæcostomy.

Private D. L., K.L.E., was admitted into a casualty clearing station on November 21, 1917, with a shell wound penetrating the left side of the abdomen. The fragment had entered the left iliac fossa in front and had passed downwards and backwards, shattering the anterior part of the crest of the ilium and emerging over the left hip. There was at least a pint and a half of fluid in the lower part of the abdominal cavity consisting largely of blood, but also of extravasated intestinal contents. Some fourteen hours had elapsed since the patient was hit, and this fluid possessed a distinctively offensive odour; the damaged segment of the colon was resected—about two and a half inches in all—and an end-to-end union performed. The wounds of entry and exit were widely excised, the loose fragments of the damaged bone were removed, and Carrel's treatment carried out with vigour; a temporary cæcostomy was performed. The patient made a good recovery and by the time he was evacuated to the base his lower bowel was acting satisfactorily, and the cæcostomy had closed.

Two of these cases are of special interest inasmuch as they are resections, not only of portions of the large intestine, but also of the small. Satisfactory accounts of these two were obtained on April 23.

I would reiterate that the operation of excision of a damaged portion of large intestine is by no means advocated as an alternative to suture, but as an expedient to which it is sometimes justifiable to resort. The narration of the above cases will show that they have all been of a severe type, and that two indeed have been double resections. The purpose of the paper is merely to show that cæcostomy is a measure of safety in cases of resection and that the latter operation is justifiable in a certain few cases of gunshot injury. These cases have been operated

upon in an advanced clearing station, which in its operating theatre and in the heating arrangements of the wards bore the impress of the engineering and architectural abilities of its then Commanding Officer, but I have also been fortunate in enjoying the assistance of an anæsthetist and of operating theatre sisters of far more than ordinary skill.

Sir Harold Stiles has very kindly allowed me to make use of his name in connexion with this communication, and in a personel letter he writes: "Whenever I resect a carcinoma, an artificial anus or a fæcal fistula of the distal half of the large intestine, the last step in the operation consists, as a matter of routine, in stitching a small area of the cæcum to the abdominal wall, so that a small opening can be made into it at the end of twenty-four or forty-eight hours."

I very gratefully acknowledge my indebtedness to him for this valuable hint in surgical technique, for although I have usually made my opening in the cæcum at the same time as the resection was performed, and although the minutiæ of the actual operative procedure may differ, the idea I learnt in visits to Sir Harold at the Chalmers Hospital, Edinburgh.

For permission to use the notes of the military cases included in this paper I am indebted to Lieutenant-Colonel E. F. L'Estrange, R.A.M.C.

Lecture.

WOUND SHOCK.[1]

BY W. M. BAYLISS, D.Sc., F.R.S.,
Professor of General Physiology in University College, London.

THE usual immediate effect of a sudden injury is that the wounded man falls in a state of collapse. If the injury is not at once fatal, this state of "primary" shock is recovered from, more or less rapidly. It is evidently brought about through reflexes from the central nervous system, and resembles the condition of fainting. It may be regarded as beneficial in that it reduces the risk of hæmorrhage, allowing injured vessels to close up and clots to form. In any case, it does not require special treatment, as does the more serious "secondary" shock that frequently comes on later. This state, which was called "wound shock" by Cowell, is the subject of the following remarks.

Wound shock may vary in the mode of its onset. Occasionally the primary shock may completely disappear, and the wounded man arrive at the casualty clearing station without other signs than the actual injury itself. Again, it may disappear for a time, but be followed by a steadily increasing secondary shock, arrival being in a more or less moribund state. In other cases the primary shock may pass directly into wound shock without intermediate recovery.

The state of wound shock, although recognized without difficulty, is not easy to define. It may be said to be a general collapse, but obviously chiefly affecting the

[1] Lecture given at the Royal Army Medical College, on October 22, 1919.

circulation. The blood pressure is low, the patient is cold, pale, sweating, and often vomiting. Such a condition is also to be observed after severe hæmorrhage, even when the actual injury is slight, and it is frequently found difficult to distinguish between the two states.

The similarity suggests that the main factor is the same in both. We know this factor in the case of hæmorrhage—actual loss of blood from the body. What takes place in wound shock that can play the same part?

N. M. Keith showed that after severe injury, although the actual loss of blood might be insignificant, that actually available for use in circulation was much diminished. The method used was that known as the "vital-red" method, in which a known amount of an innocuous dye, such as vital-red, which does not leave the blood-vessels, is injected into a vein. A short time later a sample of the blood plasma is obtained, and the degree to which the dye has been diluted is measured by a colorimeter of some kind. The total volume of plasma in circulation is thus found and, by the hæmatocrite, the proportion of corpuscles to plasma is measured, and hence the total blood is known. (See Special Report No. 27 of the Medical Research Committee.)

We have next to try to find some cause for this decrease of blood in circulation, although it has not left the body. I must first refer to some experiments made by Professor Cannon, of Harvard University, who was at that time with the American Army in France, and myself. It is true that when these experiments were commenced we were on a wrong tack. In 1917, when I paid a visit to the casualty clearing station at Béthune, the prevailing view was that "acidosis" was the cause of shock. It occurred to us that lactic acid, which would be set free from muscle in a state of disintegration, might be the cause of the failure of the circulation. We crushed the thigh muscles of anæsthetized cats, and found a progressive fall of blood-pressure with a state of acidosis, which finally resulted in death. This result was found to be the same when any participation of the nerve centres was excluded by section of the spinal cord. It was due to some toxic product absorbed from the injured tissue. Before long the possibility of its being an acid substance was definitely ruled out; in fact, acids were found to be innocuous, since the organism quickly neutralizes their effect. The acidosis, in the sense of a decreased alkaline reserve, turned out to be merely the result of the defective oxygen supply, due to the failure of the circulation. We had to do, therefore, with a powerful toxic substance of some other kind. About the same time, Delbet and Quénu, in France, had also come to the conclusion that the toxic product arose from the disintegration of the proteins of the injured cells. And now came in the work of Dale, Laidlaw and Richards on the properties of a base called *histamine*. This is readily formed from one of the amino-acids, histidine, present in nearly all proteins. It was found that, in minute doses, histamine produces a state practically identical with that of wound shock. Of course, it would be hasty to conclude that histamine itself is formed in injured tissues; there are probably related compounds with the same physiological action, such as those present in peptone and extracts of boiled tissues. At the same time, Abel's work tends to show that histamine is readily split off from proteins by fairly simple procedures.

But how does this substance bring about the withdrawal of blood from effective circulation? The investigations of the workers named showed that there are two

effects which combine in various relative degree to do this. The first of these is a universal dilation of the capillary blood-vessels. Bearing in mind how large a proportion of the total blood is contained in this part of the circulation, there is no difficulty in realizing what a great effect an enlargement of this region would have in soaking up blood, like a sponge, with the result of holding it back from the heart, and therefore from the arterial side. A vicious circle is rapidly set up; the poor circulation deprives the capillaries of oxygen, the blood in them becomes more and more stagnant, while there is no natural process capable of bringing about a recovery. It may be remarked that of late years the possibility of an independent activity of the capillaries had been somewhat lost sight of, and it is one of the valuable results of the war to have drawn attention to it. The well-known effects of cold on the skin may be recalled. The colour of the skin is due to the blood in circulation through it. In individuals with what is called a "good circulation," cold makes the skin red and warm. Since the arterial blood is red, and the venous blood, as seen through the skin, is bluish, it is clear that the red skin means dilation of the arteries and a rapid flow of warm blood through the capillaries. But in some persons the skin is apt to become blue and cold. The blueness shows the presence of blood, but it must be nearly stagnant in the capillaries, since it becomes venous by losing oxygen, and cold by prolonged exposure. The arterioles are constricted, the capillaries dilated. Such a blue-grey colour of the skin has frequently been noted in wound shock, but not always, and it must be remembered that the effect of hæmorrhage would be to deprive the body of sufficient blood to fill the dilated capillaries.

We may pass on to the second of the properties of histamine which are responsible for the serious consequences of its presence in the blood. The normal property of the capillary wall by which it refuses passage to the large molecules of proteins and colloids generally is abolished. Owing to this, plasma leaves the circulation and produces a decrease in the volume of the blood, along with an increase in the proportion of corpuscles to plasma. This concentration has been noted in wound shock, and if progressive is rightly regarded as an unfavourable sign. The explanation of the reason why such increase of permeability leads to loss of fluid is rather difficult to make clear, but it is important in view of the rational treatment of hæmorrhage and wound shock. Suppose that a solution of some substance is separated from water, or from a more dilute solution of the same substance, by a membrane which is permeable to water, but not to the dissolved substance. It is found that a pressure is developed on the side of the stronger solution, owing to the fact that water passes in by the process known as *endosmosis*. At the same time, water is being pressed out by the pressure developed, and, at a particular magnitude (called the "osmotic pressure") as much passes through in one direction as in the opposite one, so that there is no longer any change. The value of this osmotic pressure, is proportional to the concentration of the solution. If the pressure on the side of the stronger solution is raised artificially above the osmotic pressure, water passes out more rapidly by filtration than enters by osmosis. The mechanism by which osmotic pressure is brought about depends on the fact that a part of the total volume of a solution is occupied by the substance dissolved; but further discussion is beyond the limits of this lecture. The important point is that the walls of the capillaries in contact with blood on the one side and with tissue fluid (lymph) on the other,

form an osmotic system of the kind described. Although the capillary wall is freely permeable to water and to salts, it is impermeable to the proteins (and other colloids) of the blood plasma. These colloids are in higher concentration in the blood than in the lymph, so that there is a continuous absorption of water due to the osmotic pressure of the colloids, which has a definite value (about thirty-five to forty millimetres of mercury). On the arterial side, the pressure is higher than this, so that filtration occurs, causing the production of lymph; or when excessive, œdema. But the greater part of this fluid is normally reabsorbed in that large area of the capillary network where the blood pressure is low. This process of reabsorption being due to the impermeability of the vessel walls to proteins, it is clear that, if this property is abolished or reduced, the normal force causing reabsorption is absent and the liquid filtered out remains in the tissues, while the volume of the blood becomes less and less. In severe cases of wound shock, an increase of tissue moisture has sometimes been observed post mortem and occasionally œdema of the lungs, especially if transfusion of blood or other liquid had been practised. It is not to be expected that it would always be seen, because a large volume of liquid could be distributed throughout the body without being noticed.

Since the absorption into the blood of a toxic substance produced in the injured tissue is responsible for the severity of wound shock, the importance of keeping the injured parts as completely at rest as possible during transit is obvious. This is the explanation of the value of the Thomas' splint in fractures of the thigh. It was also noted by McNee that the application of a tourniquet on the heart side of a wounded limb was followed by immediate benefit. We may also note the advantage of removal of the injured tissue as soon as possible, and the value of operations performed early. In experimental work, we also observed that massage of the injured muscles caused an immediate fall of blood pressure. Although the two causes mentioned, hæmorrhage and traumatic toxæmia, are the main causes of wound shock, their action is augmented by numerous other factors which have a depressant effect on the circulation of the wounded man. In the first place, the mutual action of these two is far greater than the sum of their separate effects. Thus, a loss of blood quite innocuous to a normal individual becomes serious if there is a coincident tissue injury, such an injury as would in itself be harmless without the hæmorrhage. It is rare that hæmorrhage is altogether absent, and the fact above-mentioned suggests the importance of avoiding loss of blood in operations which Bazett has shown to be greater than generally suspected.

Other adjuvant causes are cold, thirst, fatigue, and anxiety. All these sum together to increase the state of shock and the remedies are obvious. Some of these act through reflexes from the central nervous system, and the part played by such reflexes in the initiation of wound shock has been much discussed. Doubtless they play their part here, although a more or less subordinate one. At any rate, in the stage in which wound shock presents itself for treatment it is the circulatory disturbance that requires attention. A significant fact, observed by Dale, is that histamine is innocuous to a normal cat. Anæsthetics or slight hæmorrhage make it sensitive, however, and here again the frequent onset of shock during operations comes to mind.

Time forbids detailed discussion of certain other factors suggested as causes of

shock. There is no depression of the heart until the very last stages. Acidosis has already been ruled out. Deficiency of adrenalin has been found to be of no importance.

We see, then, that it is the defective volume of the blood in circulation that is the main factor, and we may inquire for a moment why this is so serious. Although the faulty blood supply to the tissues undoubtedly fails to remove carbon dioxide and other products of cell activity, it does not seem that this fact is nearly as important as the reduction in the supply of oxygen. It is remarkable, indeed, that a defective blood supply shows itself to have more asphyxiating effects than a decrease in the oxygen taken in by the lungs, at all events, until this latter reaches a profound degree. As already pointed out, the decrease in blood volume brings about a diminished inflow into the heart from the veins, hence a reduced output and a low arterial pressure. This last is one of the most obvious signs of shock and is the cause of the sweating, vomiting, cold, thirst, and pallor of the wounded man. For a time, it may sometimes be more or less obscured by reflex vaso-constriction, a point which requires repeated observations of the blood pressure after injury. It is stated that the initial stage of gas gangrene may show a high blood pressure, possibly due to central stimulation by the acids produced in the growth of the organisms. From the point of view of treatment, it is to be remembered that a rise of blood pressure, to be of permanent value, must be brought about by increasing the blood volume, not by vaso-constriction. This latter really acts deleteriously on all the tissues where it occurs, since it *reduces* the supply of blood. For this reason, the use of such drugs as pituitrin, adrenalin or calcium salts is to be deprecated and in practice has been found valueless. In general, drugs are of very little, if any, use. The lost blood volume must be replaced in some way, at all events temporarily, and this can only be done by intravenous injection of blood or other liquid.

But the obvious accessory treatment by warmth, rest, liquid to drink, or per rectum when not retained by the stomach, must not be neglected, and occasionally when the state of shock is not severe may be effective without any other procedure. At the same time, the danger of delay is so great that if no improvement occurs in a short time intravenous injection should be practised. Here I may remark that the advantage of an artificial fluid, if adequate, is plain, since there is no need to be sparing with it.

What, then, is this liquid to be? When blood has been actually lost, it is reasonable to replace it by transfusion of blood itself or the injection of preserved blood. In wound shock without hæmorrhage, it has been pointed out that what seems to be necessary is merely a temporary increase of the volume of the blood in order to enable the stagnant corpuscles to be washed out of the capillaries and the toxic substances to be destroyed or excreted. Saline solutions (even hypertonic) have been found to be useless, because they leave the blood-vessels too quickly. The reason for this will be clear from what has been said already. Since such solutions dilute the proteins of the blood, the osmotic force attracting water is decreased, while the effective filtration pressure is increased. The result is a rapid loss of liquid. In order to avoid this, it seems clear that we ought to add some innocuous colloid to which the blood-vessels are impermeable and which possesses the same osmotic pressure as the proteins of the blood. There are not many possible ones. I found a 6 or 7 per cent solution of gum acacia n

0·9 per cent. saline to be the best for the purpose and solutions containing gum were introduced into the Army in France, especially by Sir Cuthbert Wallace. The method seems to have had some success, although whether gum-saline can in all cases replace blood is still somewhat in dispute.

Even in cases of simple hæmorrhage, it is unnecessary to transfuse blood unless somewhere about three-quarters of the blood corpuscles have been lost. In such cases, the oxygen-carrying capacity is insufficient for the proper activity of the tissue cells. Amongst others, the bone marrow is unable to replace the lost corpuscles. But a loss of this extent as the result of a wound is very rare in any case that survives the immediate injury. It would imply a loss of more than three litres in a man of ordinary weight.

No treatment hitherto devised is of avail in certain cases. If the state of increased permeability has lasted for more than a few hours, depending on its degree of severity, the blood volume is not permanently increased either by blood or by gum-saline, as the liquid leaves the blood vessels. Some experiments that I have done recently have given me the impression that in some cases the treatment may not have been sufficiently persevered in. The first injection of gum-saline frequently leaves the circulation for the most part, although it may have already had the effect of somewhat restoring the normal state of the capillaries. A second or third relatively small injection after half an hour or so is then retained and the rise of blood pressure becomes permanent. Another circumstance that makes recovery impossible in animals, cats for instance, is the effect of the prolonged bad circulation on the nerve centres, especially the respiratory centre, which become irrecoverably paralysed. How far this factor operates in man is uncertain, but it has been noticed that the mental faculties appear to be alert, even in severe shock. The obvious conclusion to be drawn from these hopeless cases is that treatment to be effective admits of little delay.

Report.

REPORT OF A COMMITTEE OF INQUIRY REGARDING THE PREVALENCE OF PELLAGRA AMONG TURKISH PRISONERS OF WAR.

(*Continued from p.* 527.)

APPENDIX III.

PATHOLOGICAL SECTION.

WITH ANALYTICAL SUMMARY ATTACHED, OF THE RESULTS OF 116 POST-MORTEM EXAMINATIONS PERFORMED ON PELLAGROUS AND NON-PELLAGROUS TURKISH PRISONERS OF WAR.

October-November, 1918.

By post-mortem examinations carried out on the above, an endeavour was made to elucidate the following points:—

(A) The most common direct or immediate cause or causes of the mortality occurring at this date amongst the Turkish prisoners of war?

(B) The direct or immediate causes of death in those prisoners of war who either had been diagnosed clinically as suffering from pellagra or who exhibited signs of this disease at the post-mortem examination?

Seventy-seven cases were examined at No. 2 Prisoners of War Hospital, Abbassia, and sixty-eight cases at No. 6 Egyptian Hospital, Kantara. The results are summarized in Tables I and II at the conclusion of this appendix.

Two other morbid conditions were also encountered with noteworthy frequency, viz.: Pulmonary tuberculosis and intestinal helminthiasis, *Ascaris lumbricoides* being the commonest parasite of this class met with. That phthisis in one or other of its forms was found in no less than twenty cases (approximately seventeen per cent), and ascarides in nineteen, are facts which supply a significant indication of the very poor hygienic and dietetic regime under which this class of Turkish troops had been living prior to capture.

(A) *Predominant Direct Causes of Total Mortality.*

Certain exceptional features of the morbid anatomy of the *broncho-pneumonia* from which so many died demand special mention. Death supervened at all stages of its evolution, so that it is possible to present a chronological summary of the stages through which the affection was observed to pass. The earliest phase was a general acute venous congestion of the entire organ, amid which could be felt, rather than actually seen, nodular areas of commencing broncho-pneumonia. These were soon transformed into foci of reddish-grey consolidation, the margins of which were, as a rule, ill-defined and merged gradually into the dark congested pulmonary tissue of the immediate neighbourhood. The affection was usually widely disseminated throughout the lungs, so that not infrequently, by almost complete coalescence of the consolidated foci of neighbouring bronchial stems, the characters of a lobar pneumonia were closely simulated. A true lobar affection, although it sometimes occurred, was, however, not the rule.

From this stage onwards, a departure from the ordinary type of broncho-pneumonia was clearly apparent. The succeeding stage of grey hepatization was scarcely established before the picture was completely changed by widespread puriform softening. The fresh-cut section of a lung at this stage was covered with numbers of suppurating foci having the racemose arrangement indicative of their bronchial origin. The pus was tenacious, and, on removal by washing, the small ragged cavities in which it had been confined were demonstrable, each surrounded by a narrow surviving zone of grey alveolar consolidation. In some cases the periphery of certain of these cavities, and in others that of all, had undergone an even more rapidly destructive process, viz., gangrene. Indeed, in the most severe cases the lungs were riddled with large numbers of small bluish-black cavities of gangrenous character, the stages of consolidation and puriform softening being scarcely anywhere visible. It was difficult to resist the impression in these cases that the virulence of the infection was sometimes sufficient, in a very debilitated subject, to precipitate gangrene at a comparatively early stage of the malady. The odour given off by the lungs in the two later phases just described was of a sweetish, nauseating character; it was definitely noted that the penetrating and highly offensive odour of pulmonary gangrene of longer duration due to other causes was absent.

A pulmonary affection of this intensity, as might be readily expected, frequently involved the pleura. An associated acute fibrinous pleurisy was common, and when the more severe manifestation occurred near the sub-pleural zone, necrosis of the pleura was frequently observed.

Death of the patient had in these instances forestalled the supervention of pyo-pneumo-thorax.

It is noteworthy that in no single instance was there evidence of pericardial infection.

The bronchial glands, although the seat of congestion and acute inflammatory œdema, did not reach the dimensions which these glands so frequently attain when associated with lobar or widespread lobular pneumonia of less virulent intensity.

From observation of those cases in which other toxæmic diseases were absent, it may be stated that the nature of the lung infection was such as to produce the acute degenerative changes of toxæmia in the sensitive parenchymatous organs and viscera. Indeed, the latter were pronounced, although death had occurred at the earliest stage of the pulmonary affection. It appears, therefore, reasonable to infer that a scepticæmia may have marked the commencement of the disease, and that the pulmonary affection was one of its more pronounced local manifestations.

The prevalence of a past or still active *malarial infection* in a considerable proportion of the total cases examined is especially noteworthy. The relatively high proportion of cases in which malaria is recorded amongst the group examined at Kantara as compared with that from Cairo is probably to be explained by the fact that at Kantara many fresh preparations from spleen and bone marrow were examined whilst the autopsy was in progress, and the discovery of parasites proved the existence of malaria in some cases in which the naked-eye characters of the organs alone might not have justified a positive conclusion. A considerable proportion of the parasites observed were of the

malignant variety. There is no doubt that the debilitating influence of this disease greatly contributed to the number of fatalities from pneumonia.

In this connexion the damaged condition of the colon from *dysentery* must be also emphasized. Reference to the various Appendices will at once show how widespread dysentery has been amongst these Turkish troops. No less a proportion than sixty-one per cent of them were actually, or had recently been, suffering from dysentery—the ulcers in the latter cases being still unhealed. That is to say, dysentery was just exactly as common a disease as the pneumonia which actually killed them. Apart from actual numbers, the impression gained ground as the autopsy work progressed, that it was quite exceptional to see a colon whose mucous membrane could be fairly regarded as undamaged or unaltered in any way.

That an epidemic form of pneumonia, highly virulent in itself, should have occasioned such a heavy mortality requires therefore no explanation, in view of the enfeebled resistance of these troops, who, besides presenting evidences of inadequate nutrition prior to capture, were debilitated by such diseases as dysentery and malaria.

(B) *Causes of Death among Pellagrous Prisoners of War.*

It only remains to comment very briefly on the morbid anatomy of the sixty cases who were diagnosed as suffering from pellagra. The diagnosis of this disease, in the case of the group examined in Cairo, had been made from clinical evidence; in the case of the Kantara group only those who presented signs of a characteristic rash on careful scrutiny at the autopsy were regarded as pellagrous—no clinical evidence being, in the majority of these cases, available.

Amongst the 118 unselected cases examined were found twenty-three which, on one or other of the foregoing grounds, could be regarded as definitely pellagrous. These therefore form part of the group of sixty pellagrous subjects separately charted, the remaining thirty-one being definite pellagrins clinically diagnosed in Cairo.

The direct causes of death and the concomitant or associated diseases in this pellagrous group are recorded in Table II. It is at once apparent that the pellagra group, in these respects, differed in no way from the remainder. Only in two cases (Nos. 52 and 58) was the somewhat negative morbid anatomy of the marasmic pellagrin left unobscured by the co-existence of an intercurrent acute disease. It is seldom that the pathologist is given the opportunity for the study of the morbid anatomy and histology of pellagra unmasked by the changes due to other diseases.

Material for histological study has been appropriately preserved from these and other cases, but, apart from the fact that it has not been possible to complete this for inclusion in the present report, it was felt by us that no reliable contribution towards this aspect of pellagra would be possible, in view of the very restricted nature of the source from which any fact observed could with safety be recorded as specifically belonging to pellagra.

CONCLUSIONS.

(1) That acute pneumonia, chiefly of broncho-pneumonic type, was the direct cause of death in by far the largest proportion of causes, sixty-two per cent of the whole dying from this cause.

(2) That, with few exceptions, these prisoners had contracted prior to capture, and were suffering from, grave debiliating diseases, of which the principal were:—

(i) Dysentery, chiefly of the bacillary variety, and

(ii) Malaria.

(*Signed*) ALEX R. FERGUSON,
Major, R.A.M.C.
(*Signed*) WM. CAMPBELL,
Captain, R.A.M.C.

PELLAGRA REPORT.

Before the appointment of the Pellagra Research Committee, the D.M.S., E.E.F., had sent me to investigate pellagra amongst the Turkish prisoners of war. Acting on the following hypothesis, which agrees with the findings of the Committee, I collected material which has now been sectioned and examined.

The hypothesis was as follows: (1) Pellagra is associated with a diet inadequate in regard to its protein constituents. (2) The similarity of the symptoms of pellagra to those of Addison's disease suggests that the protein defect may be a lack of aromatic amino-acids which are necessary for the formation of adrenalin.

(3) The symptoms of pellagra suggest deficient activity of the sympathetic nervous system, and it is possible that the failure of the sympathetic nervous system may result from a deficient supply of adrenalin.

Sections of adrenals did not show any distinctive differences between those from cases of pellagra and those from cases of other diseases, but most of the adrenals appeared somewhat abnormal, showing hyperæmia and shrinkage of cells in both cortex and medulla. The weights of the adrenals from cases of pellagra were less (9·3 grammes average of fourteen cases) than those from other wasting diseases (10·9 grammes average of twelve cases).

Sections of the ganglia of the sympathetic nervous system from four cases of pellagra show marked plasmolysis of the ganglion cells, whilst those from three cases not diagnosed as pellagra show the ganglion cells turgid and occupying their full volume. It is not likely that this is a post-mortem change, as some of the plasmolysed ganglia were obtained a shorter time after death than some of the non-plasmolysed.

The ganglia that have been examined are superior cervical, stellate and semilunar. Two photomicrographs are given to illustrate the differences between the ganglia from pellagrous and non-pellagrous cases.

It remains to be found out if this plasmolysis is always present in pellagra, and if this plasmolysis occurs in diseases other than pellagra—for instance, those in which the sympathetic nervous system may be expected to be affected.

These results suggest that the Turkish prisoners of war were a population suffering from such a food deficiency that the adrenals of all of them were abnormal, but that it was only those who developed lesions of the sympathetic nervous system who showed the symptoms of pellagra.

H. E. ROAF.

TABLE I.—AN ANALYSIS OF THE RESULTS OF 118 AUTOPSIES PERFORMED ON UNSELECTED PRISONER OF WAR CASES DYING IN PRISONER OF WAR HOSPITALS AT CAIRO AND KANTARA.

(a) Direct Causes of Death.

Number of cases dying from :—

(1) Pneumonia	71	or	60·10 per cent
(2) Pulmonary tuberculosis	14	,,	11·90 ,,
(3) Dysentery, bacillary	10	,,	8·50 ,,
(4) ,, amœbic	3	,,	2·50 ,,
(5) Malaria	10	,,	8·50 ,,
(6) Nephritis	4	,,	3·40 ,,
(7) Scurvy	2	,,	1·70 ,,
(8) Enteric	1	,,	0·85 ,,
(9) Peritonitis, acute	1	,,	0·85 ,,
(10) Appendix abscess	1	,,	0·85 ,,
(11) Hydatid cyst of liver (suppurating) ..	1	,,	0·85 ,,
	118		100·00

(b) Morbid Conditions present in Individual Cases.

Total number of cases suffering from :—

(1) Pneumonia	74	or	62·6 per cent
(2) Dysentery, bacillary	54	,,	45·8 ,,
(3) ,, amœbic	18	,,	16·2* ,,
(4) ,, healed	14	,,	11·18 ,,
(5) Malaria	44	,,	37·30 ,,
(6) Pellagra rash	21	,,	16·90 ,,
(7) Worms	19	,,	14·10 ,,
(8) Pulmonary tuberculosis	20	,,	15·90 ,,
(9) Nephritis	14	,,	11·80 ,,
(10) Syphilis..	4	,,	3·40 ,,
(11) Scurvy	3	,,	2·50 ,,
(12) Banti's disease	1	,,	0·85 ,,
(13) Hepatic cirrhosis (alcoholic type)	1	,,	0·85 ,,
(14) Leptomeningitis (chronic)	1	,,	0·85 ,,
(15) Enteric	1	,,	0·85 ,,
(16) Peritonitis (acute)	1	,,	0·85 ,,
(17) Appendix abscess	1	,,	0·85 ,,
(18) Hydatid cyst of liver (suppurating) ..	1	,,	0.85 ,,

* 61 per cent had open dysenteric lesions in colon.

TABLE II.—Analysis of the Results of Sixty Autopsies performed on Pellagrous Prisoners of War.

Note.—Forty-six cases of the series, clinically diagnosed as pellagra, were examined at No. 2 Prisoners of War Hospital, Abbassia. Fourteen cases, not clinically diagnosed as pellagra, but which showed post-mortem pellagrous eruptions, were examined at Kantara.

(*a*) *Direct Causes of Death.*

(1) Pneumonia	38	or	63·4	per cent
(2) Dysentery, bacillary	8	,,	13·3	,,
(3) ,, amœbic	2	,,	3·3	,,
(4) Pulmonary tuberculosis	4	,,	6·7	,,
(5) Malaria	3	,,	5·0	,,
(6) Pyæmia with septic nephritis	2	,,	3·3	,,
(7) Pellagra	2	,,	3·3	,,
(8) Suppurating cyst of liver (hydatid)	1	,,	1·7	,,
	60		100·0	,,

(*b*) *Morbid Conditions present in Individual Cases.*

(1) Pellagra	60	or	100·0	per cent
(2) Pneumonia	39	,,	65·0	,,
(3) Marasmus, extreme	35	,,	58·0	,,
(4) Dysentery, bacillary	28	,,	46·6	,,
(5) ,, amœbic	15	,,	25·0	,,
(6) Malaria	16	,,	26·6	,,
(7) Worms	12	,,	20·0	,,
(8) Pulmonary tuberculosis	5	,,	8·0	,,
(9) Nephritis	3	,,	5·0	,,
(10) Pyæmia	2	,,	3·3	,,
(11) Banti's disease	1	,,	1·7	,,

APPENDICES IV and VI.

Bacteriological and Hæmatological Investigations on Pellagrous Prisoners of War.

The summary of work done on selected pellagra cases at No. 2 Prisoners of War Hospital, Cairo, is as follows:—

I.—*Examination of Fæces for Bacteria.*

The stools of 100 cases of pellagra were examined, with the object of finding out if there were any pathogenic bacterium present which might have a bearing on the ætiology of pellagra. Of these 100 stools, four had the microscopical features of acute bacillary dysentery, and nine others presented those of the same disease in a chronic form. Thus at least thirteen per cent of the cases were suffering from some stage of bacillary dysentery at the time of examination. The majority of the stools were liquid, fæcal in character and, being rich in indol and skatol, had a highly offensive odour. Formed stools were rarely met with.

The stools were plated on MacConkey's neutral-red-lactose-agar medium, and incubated for twenty-four hours at thirty-seven degrees centigrade. In addition to non-lactose-fermenting colonies, numerous lactose-fermenting organisms were also investigated. Classical dysentery bacilli were isolated in five cases; three of

these proved to be *B. Shiga*, and the other two belong to the *Flexner-Y* type. Four atypical dysentery bacilli were isolated from other cases. These strains have been isolated with great frequency from the stools of cases of bacillary dysentery, in all stages, in many of the military laboratories of the E.E.F., and must be regarded as concomitant, or even contributory, organisms in the production of this disease.

Other potential disease-causing coliform organisms of non-lactose-fermenting properties were *B. Morgan No. 1* (five times), *B. fæcalis alkaligenes* (six times), and *B. paracolon* (five times). The two former may be dismissed, as they sometimes occur in stools without causing any symptoms, but the paracolon bacillus is held by competent observers to give rise to a dysenteriform condition above the ileo-cæcal valve. The lactose-fermenting coliform organisms and the various cocci investigated were the same as those which are encountered in the routine examination of the stools of the general hospital population. (See Table I.)

II.—*Blood Cultures.*

Blood cultures were taken from seventeen well-marked pellagra cases, avoiding those who were in a critical condition from the association of some intercurrent malady. Broth and peptone were the media used, nothing inhibitory to general growth being present. The results were uniformly negative.

III.—*Complement Content of Blood.*

The few cases of well-marked Pellagra examined showed the complement content to be ample.

IV.—*Cerebrospinal Fluid.*

Aerobic and anaerobic cultures were carried out on eleven cases. Various media were employed for culture purposes, namely (1) defibrinated blood (chocolate medium), (2) blood-smeared glucose-agar, (3) Loeffler's serum, (4) Nasgar. All the results were negative.

V.—*Blood Smears for Parasites.*

Before the arrival of Dr. Woodcock I had examined twenty-eight cases. In seven of these, malignant tertian parasites were found, and in five others those of benign tertian. The spirochæte of relapsing fever was found once. These findings, so far as they go, are in accordance with the results recorded in Dr. Woodcock's report.

Conclusion.

The bacteriological examinations of the fæces, blood and cerebrospinal fluid as well as the microscopical examination of blood films give no positive indications regarding the ætiology of pellagra.

BLOOD EXAMINATIONS MADE IN CASES OF PELLAGRA, WINTER AND SPRING, 1917.

Appended are the hæmatological data obtained by me as a result of the examination of the blood of fifty cases of pellagra which occurred in this hospital during the above period. These are shown in Table II. The average count is as follows:—

R.B.C. ..	4,115,800
W.B.C...	5,050
Hb. ..	70·7 per cent
Colour index	0·86

The R.B.C.s vary from 2,500,000 to 6,000,000. In no case does the leucocyte count go above normal physiological limits, and frequently there is a marked leucopenia.

As to the differential counts, the polymorphonuclear leucocytes are generally sixty-three per cent or over, rising to as high as seventy-nine per cent, but with in this case a white count of only 4,600. The lymphocyte count in three cases is very high, 58 per cent, 48 per cent and 40 per cent being noted, but apart from such anomalous cases the count is generally within normal limits.

The large mononuclear count is generally 5 or 6 per cent, but in 14 cases it is 10 per cent or over. This is almost certainly due to previous malarial infection. In examining smears of these bloods, the red cells appeared to be smaller and more shrunken than those of other hospital cases, though poikilocytosis was very rare. Basophilic degenerations were also only rarely noted. The high mononuclear count in fourteen (i.e., twenty-eight per cent) of this group would point to a recent malarial infection, and is in accordance with Dr. Woodcock's findings in his series.

CONCLUSIONS FROM THE SERIES OF BLOOD COUNTS.

(1) There is an anæmia, chlorotic in type.

(2) There is no leucocytosis. The white cell count tends to be below normal.

(3) There is no lymphocytosis that can be attributed to pellagra.

(4) The occasional large mononuclear increase is probably due to an associated malarial infection.

(5) There is no eosinophilia.

(6) The blood picture therefore presents no evidence that pellagra can be attributed to either a bacterial or protozoal infection.

(*Signed*) RICHARD PATON,
Capt. R.A.M.C.

TABLE I.—ORGANISMS ISOLATED FROM PELLAGROUS STOOLS.

		Times isolated
B. Grunthal	.. ..	3
B. coli communis	.. ..	25
B. lactis aerogenes	.. ..	7
B. neapolitanus	.. ..	5
B. MacConkey 71	.. ..	4
B. cloacæ ..	.. ..	3
B. oxytocus perniciosus	.. ..	1
B. MacConkey 74	.. ..	2
B. coli anaerogenes	.. ..	1
B. coscoroba	.. ..	2
B. Shiga ..	.. ..	3
B. Flexner Y	.. ..	2
Atypical dysentery	By M. B. L. Kantara Table, two No. 9, one No. 13, one No. 45	4
B. paracolon	.. ..	5
B. fæcalis alkaligenes	.. ..	6
B. Morgan No. 1	.. ..	5
Streptococcus fæcalis ..	.. ..	19
Staphylococci, etc.	*Diplococcus Crassus* twice	9
Gram-negative cocci ..	.. Unclassified	3
B. pyocyaneus	.. ..	0

TABLE II.—BLOOD EXAMINATIONS—PELLAGRA.

Serial No.	Red corpuscles	White corpuscles	Hæmoglobin percentage	Percentage proportions of the various kinds of leucocytes			
				Polymorph leucocytes	Lympho-cytes	Large hyaline	Eosino-philes
1	4,750,000	7,400	80	67	25	9	1
2	4,340,000	5,200	75	67	26	6	1
3	3,700,000	7,000	65	77	16	7	—
4	4,190,000	6,800	60	63	25	9	3
5	4,580,000	5,400	60	62	27	11	—
6	4,750,000	5,200	75	58	31	11	—
7	4,620,000	4,200	80	59	32	8	1
8	4,400,000	7,000	70	72	22	6	—
9	3,870,000	6,400	60	77	15	7	1
10	4,960,000	5,600	70	73	21	6	—
11	5,220,000	4,400	80	63	26	11	—
12	4,420,000	6,200	70	50	40	10	—
13	3,170,000	3,000	75	75	19	8	—
14	6,000,000	4,800	75	66	25	9	—
15	3,520,000	3,600	70	47	42	10	1
16	4,400,000	3,800	70	69	24	6	1
17	3,780,000	7,800	80	71	21	8	—
18	3,910,000	3,400	70	55	39	6	—
19	3,700,000	4,600	60	79	16	5	1
20	4,200,000	6,600	75	58	32	10	—
21	3,460,000	3,300	65	59	36	5	—
22	5,370,000	6,200	70	68	21	9	2
23	3,000,000	7,200	50	68	26	6	—
24	4,520,000	3,800	55	60	30	10	—
25	2,900,000	4,200	75	68	25	7	—
26	4,400,000	3,500	70	60	35	5	—
27	4,680,000	6,000	75	71	20	9	—
28	3,960,000	4,600	80	67	27	6	—
29	3,970,000	6,200	75	55	35	9	—
30	3,000,000	6,080	75	67	27	6	—
31	2,540,000	5,600	60	69	26	5	—
32	3,780,000	3,400	70	63	30	6	1
33	3,830,000	3,400	75	61	30	7	2
34	3,350,000	5,600	65	76	19	5	—
35	4,400,000	5,600	70	61	32	6	1
36	3,740,000	4,600	70	61	29	9	1
37	3,850,000	7,800	75	25	58	17	—
38	4,910,000	4,200	70	64	26	10	—
39	4,930,000	6,000	70	65	24	10	1
40	3,750,000	5,600	70	70	18	7	5
41	4,100,000	4,000	75	63	27	10	—
42	3,600,000	6,000	70	52	34	14	—
43	3,730,000	4,200	65	57	31	12	—
44	3,500,000	4,000	60	36	48	16	—
45	3,850,000	6,400	70	65	27	7	1
46	3,840,000	4,200	66	68	25	7	—
47	3,480,000	5,400	75	61	34	5	—
48	5,380,000	5,000	70	33	36	9	2
49	4,300,000	5,000	80	68	27	5	—
50	4,200,000	4,300	60	58	36	6	—

Note.—Any clinical facts which might have explained the exceptionally high degree of lymphocytosis recorded in these few cases unfortunately cannot now be produced, no clinical notes being available.

(*To be continued.*)

Reviews.

William Howard Lister. By Walter Seton, with a foreword by Lieutenant-General Sir Ivor Maxse, K.C.B., C.V.O., D.S.O. Privately printed for the author by the Medical Society. Copies, 10s. 6d. post free, can be obtained from the Senior Clerk, University College, London, Gower Street, W.C.

Dr. Seaton's Memoir of the late Captain William Howard Lister, D.S.O., M.C., R.A.M.C. (T.), is a biography of an able and distinguished member of our profession, who was killed in action in his 31st year on the Italian front on August 9th, 1918.

In the foreword Sir Ivor Maxse describes Lister's character and gives an account of his gallantry and devotion to duty, and shows how invaluable Lister's reliable temperament and immovable standard of duty were to the troops whenever there was fighting. Lister served in a field ambulance under Sir Ivor, who commanded the 18th Division.

Chapter I (1887-1905) is a short account of Lister's early years until he entered University College, London, as a medical student in 1905. The following chapter describes the prominent part that the deceased took in connexion with the celebrated "Brown Dog" affair at Battersea and how Lister's efforts were the means of provoking a vigorous controversy in the *Times*. Eventually the bronze statue of the dog with the offending inscription was removed. In Chapter III (at University College and Hospital, 1908-1912) we find a record of Lister's activities in connexion with the public life of his college and how he took a leading part in every fresh undertaking that affected the interest of the students; as an example of his initiative and energy we quote the following: "He set himself the task of making the University of London worthy of the pride and affection of the citizens of the capital of the Empire and was responsible in his undergraduate days, and in a sense almost single-handed, for drawing the students of the University together to a degree which those who were trying to guide its destinies from official positions scarcely dreamed of."

Chapter IV (The Balkan War and the "Cobequid," 1912-1914). The author describes how Lister went out in October, 1912, as a dresser with a detachment of the British Red Cross Society to Greece. At first he worked in a hospital in Athens, then in a hospital ship in the harbour of Volo until the Greeks captured Salonica. He and his detachment were then transferred to Salonica where they took over the Municipal Hospital of about 200 beds. Subsequently, he worked among some of the 40,000 Turkish refugees from Macedonia. The condition of these refugees was pitiable and was aggravated by "almost every known disease." Lister made one excursion alone into the interior of the country, and was lost for several days in the Macedonian hills. After exciting experiences he succeeded in making his way back to Salonica. Lister was awarded the Balkan War Medal and Distinguished Service Decoration of the Greek Army and received a letter of thanks from King Constantine in recognition of his services. Lister qualified in October, 1913 (M.R.C.S.Eng., and L.R.C.P.Lond.). His untimely death prevented him from taking the degree of the London University.

The remainder of this chapter is a narrative of the voyage of the Royal Mail Steam Packet "Cobequid" written by the third officer. Lister sailed in this vessel as ship's surgeon in November, 1913. The "Cobequid" was destined to open up a service between Canada, Bermuda, the West Indies and South America. The vessel was wrecked off the Nova Scotia coast in January, 1914. A photograph of the wrecked vessel covered with snow and icicles gives the reader some

idea of the exposure and dangerous privations which the passengers and crew underwent. An instance of Lister's splendid behaviour is shown by his refusing to leave the ship until all the passengers had been taken off.

In the latter part of the memoir, which is the most interesting, the author gives an account of Lister's experiences on service and how he was one of the first to take a temporary commission in the Royal Army Medical Corps. He was sent out to France in August, 1914, and served with a field ambulance and as a regimental M.O., and was severely wounded in the right elbow joint by machine-gun fire while gallantly rescuing a wounded officer. As an example of this officer's high sense of duty he refused to accept an appointment at home when convalescent, but succeeded in getting back to France in March, 1916, from a Mediterranean base and in a short time was back again with a field ambulance. One or two of his many acts of individual bravery are described in detail, when he was in charge of a bearer division during the Somme offensive. The chapter includes accounts of many heroic incidents in which Lister played a most prominent part.

In June, 1918, Lister left England for the Italian Front, and on August 9 was killed instantaneously by the concussion of a trench mortar bomb.

Sir Ivor's remarks cannot help being a great source of consolation to Lister's bereaved relatives and many friends, and we feel that we voice the feelings of the whole profession when we deplore the irretrievable loss of this gallant officer.

H. W. G.

TRENCH FEVER: REPORT OF COMMISSION OF AMERICAN RED CROSS COMMITTEE, 1918. Oxford University Press.

The inception, plan of campaign, and actual carrying out of this investigation, will rank as one of the most remarkable researches, completed against time, and under the adverse conditions of active service.

The Report, which comes from the pen of Major Strong, is exceptionally well arranged, terse and graphic.

To one who was not behind the scenes it is difficult to understand why a definite plan of campaign was not formulated at a much earlier date by the Medical Department of the British Expeditionary Force, for as early as the end of 1915 and the beginning of 1916 the occurrence of a disease characterized by febril relapses and subsequently named Trench Fever had been recognized. The plea of paucity of medical officers and volunteers for the investigation of a disease which was causing a very high casualty rate in the actual fighting forces is suggestive of a want of driving power and initiative.

The investigation by the American Committee with reference to the possible association of the typhoid group of diseases with trench fever proves conclusively by the evidence in this report that there is no connexion, and supports the results obtained by McNee, Brunt and Renshaw.

It is noted that the American Committee varied the process elaborated by Dreyer for the titration of the agglutinin content, with the result that they have produced curves in many instances widely different from those obtained by Dreyer and his fellow-workers. It is suggested, therefore, that this portion of the work should be repeated if opportunity should offer.

It is commonly held that the virus is transmitted by reason of lice fæces being rubbed into abrasions or biteholes in the skin of the hosts. In Chapters X and XI of this Report, cases of infection are described as caused by pure biting experiments. But as the Report points out, "in the absence of exact knowledge of the morphology of the virus, and its location in the louse, and the difficulty of devising a type of experiment in which it is certain that the only factors operating are the stabbing and infection of saliva, it is impossible to do anything but merely state that this seems possible."

For the same reason it is impossible to be precise as to the infectivity of the dejecta of trench fever cases. A few rough experiments produced negative results as regards fæces, one positive case only from sputum, but more positive results from urinary sediment. The Report concludes that trench fever "is a disease entity: when it assumes certain forms it is quite characteristic; when it assumes others it can only be diagnosed by taking all its positive features into consideration and by ruling out other diseases. Apart from pain and tenderness the special features of the disease were referable to the eye, skin, spleen and circulatory system."

PHYSICAL AND OCCUPATIONAL RE-EDUCATION OF THE MAIMED. By Jean Camus and W. F. Castle. London: Baillière, Tindall and Cox, 1918. Pp. xi + 195. Price 5s.

This book presents in an admirably condensed form the principles for re-educating the disabled; and the subject falls under two distinct headings: physical re-education and occupational re-education; the latter concerned with men who have lost sight or a limb or who, short of that, are still unable to follow their former occupation. The author deals with this class in a practical way, and evidently has made a study of the subject apart from its medical aspects; and there are so many considerations to be taken into account in deciding what occupation a man can be fitted for, quite apart from surgical ones, that the question is not one on which the majority of medical men are able to give an opinion. A medical man cannot have the requisite knowledge of the various crafts and trades and branches thereof with all the technicalities concerned, to enable him to know what a man can do, either with or without any artificial aid, in any particular trade. The condition of the labour market, the demand for skilled or unskilled workmen, trade union regulations, the willingness of employers to engage maimed men, are all considerations which are outside any medical aspects. The author's keynote as regards artificial appliances is simplicity combined with efficiency for the purpose demanded, and he utters a word of warning against "apparent miracles" performed by some apparatus. A man may be fitted with a limb enabling him to pick up a pin and make a cigarette and form an interesting exhibition to visitors to the establishment, when the man really wants aid to enable him to use a hammer, a drill, or a plough. The author brings out the point that an ingenious workman will invent an aid for himself superior to anything made by a surgeon or surgical instrument maker, and this is clearly due to the fact that the workman knows and feels what he wants, which the others cannot do.

One principle noted by Dr. Camus is well worth emphasis; make the man's sound limbs take on the function of the maimed one, and avoid the delusion that an artificial hand, however complicated, can in any degree be a substitute for the lost one; and that "An apparatus to take the place of an arm or hand" bears as often as not no resemblance to the natural organ, but is a special adaptation for the work to be done." In physical as apart from occupational re-education, the author's keynote is—volition, which indeed he applies also to occupational re-education. The first page of the book might well be written large in red letters in every hospital in this country, because the principle therein enunciated is ignored to a lamentable extent. We must allow that the method of putting the principle into practice is subject to modifications according to facilities and perhaps racial characteristics. Dr. Camus would employ farm labour as a means of physical re-education to fit a man for return to duty. Such a method is not practicable in this country, nor is it necessary; nor would it be, in many cases, the quickest way in which the function of a disabled limb would be recovered. It has been proved that class work in an ordinary equipped gymnasium in which the

"simplest voluntary movements which call for some of the most complicated syndromes known to physiologists" are performed under a competent instructor is the quickest way to re-educate a man's will-power. It is the quickest way owing to the fact that such variety can be introduced into the work, the whole body exercised at the same time as the disabled limb, and in such ways that no group of muscles become fatigued and constantly varying degrees of will-power are called upon. This forms the best possible preliminary re-education to qualify the man for occupational re-education. Dr. Camus draws attention to the disability of a man being set to productive work, and instances the difference between a man turning a wheel and a pump handle; of course in a well-conducted gymnasium no man would be kept "turning a wheel" in such a way as to bore him; and we think Dr. Camus perhaps under-estimates the psychic effect, which we have often seen, of a man being able to perform an exercise in a gymnasium which he thought he would never be able to do. The trite teaching of this book may well be taken to heart by those responsible for the men now on our pension list who are suffering from want of some one to set them to "simplest voluntary movements," and whose volition is being allowed to dry-rot for want of a stimulus to start their motor areas again.

FIELD SANITATION. By Major R. St. J. Macdonald, M.D., C.A.M.C. Oxford University Press. 1918.

These lectures were delivered at the Canadian Sanitary School to officers, non-commissioned officers and men engaged in sanitary work. They are concise, clear, and form a most useful practical epitome of Field Sanitation. Much of the new matter might be with advantage incorporated into the next edition of the Manual of Military Hygiene. The illustrations of improvised appliances are particularly clear, and the means and materials for construction are usually within the reach of a field army.

There are a few omissions which might be with advantage made good. For instance, with regard to watering horses, where mounted troops, such as cavalry and artillery, are present in large numbers, sanitary control of watering places is absolutely essential, and the longer the period spent in one area the greater the necessity for supervision and the improvisation of such arrangements as circumstances permit.

The next point is surface drainage. As the book deals with rear as well as advanced areas, and frequent reference is made to camps, it appears within the scope of the work. Detailed improvements in the flooring, and immediate adjuncts of cookhouses, huts, latrines, ablution places, and water-cart stands, are largely discounted if measures are not taken to deal with surface drainage.

Some minor points arise. Reference to them is probably omitted owing to necessity of limiting length of lectures.

Pages 26, 27.—Petrol tins: If left tainted with petrol are a source of constant complaint. As these are filled well behind it is often possible to utilize steam from Foden lorry "Thresh" by holding opening of tin on suitable sized exhaust cock for a few seconds.

Page 35.—Striking of tents to expose ground. Provision of trench round.

Pages 45, 46.—Food: Cool storage can be improvised by walls of turves or sandbags with air space between walls of store.

Page 89.—In addition to Divisional baths, improvised baths are in great request.

The illustrations of sanitary appliances might be extended as regards field cookery. A heater (p. 150) is the only one shown. Excellent ovens for small detachments can be made from tins encased in clay. Sketches of improvised bathing arrangements would be useful.

GUNSHOT INJURIES TO THE BLOOD-VESSELS. By Sir George H. Makins, G.C.M.G., C.B. Bristol: John Wright and Sons, Ltd. Pp. xii+251. Price 21s. net.

The author of this volume, who has had almost unparalleled opportunity of studying his subject while acting as Senior Consulting Surgeon to the British Expeditionary Force in France, here sets forth his own experiences of gunshot injuries of the vessels. In the first half of the book the subject is treated in general, while in the latter half the reader will find details of the clinical material from which the expressed views of the author have been deduced.

Though the war can scarcely be said to have made any startling additions to the surgery of vessel injuries, it has yielded much accurate information, some of which will undoubtedly prove of value in civil surgery.

The vast majority of vessel wounds produced during the recent war have been of the contused and lacerated variety. Indeed, careful examination has shown that contusion of the arterial wall has been more extensive than was previously supposed. It has been amply demonstrated that contusion and non-penetrating laceration of arteries frequently play an important part in the causation of thrombosis, secondary hæmorrhage and aneurysm.

The value of auscultation, both local and over the præcordial region, as an aid in diagnosis of injuries to vessels has been emphasized.

The effects of occlusion of various arteries on the parts supplied by the peripheral branches have been carefully studied. It is of interest to note that the author adduces evidence to prove that the vitality of the distal parts is not so likely to suffer if the companion vein is likewise obliterated. He strongly recommends that, should the popliteal artery have to be ligatured, it is wise also to tie the popliteal vein. He would, on the same principle, ligature the internal jugular vein when it is necessary to occlude the common or internal carotid arteries. In wounds of the main vessels of the extremities, Tuffier's tube has in many cases tided the patient over a critical period.

Proximal ligation of a main artery at the seat of election for primary or secondary hæmorrhage is condemned. One exception, however, is made. In hæmorrhage from one of the vessels of the buttock close to the point at which they emerge from the pelvis, practical experience teaches that it is justifiable to ligate the internal iliac artery or its posterior division.

Unfortunately the prevalence of sepsis has largely precluded the repair of vessels by suture. Nevertheless, in the later complications of vessel injuries, arterial reconstruction has had considerable success and those cases recorded in the chapter dealing with the vessels of the neck are specially noteworthy.

The author deems it unnecessary to use the very fine silk recommended by Crile, and has found Japanese silk 0000 and corresponding needles efficient and much easier to manipulate.

This contribution contains a wealth of clinical material and the opinions expressed, coming from so eminent a source, are of great value. Indeed, the volume is a "war classic" and will be read now and in years to come with the greatest interest.

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Original Communications.

AN ANTI-MALARIA CAMPAIGN IN PALESTINE.

AN ACCOUNT OF THE PREVENTIVE MEASURES UNDERTAKEN IN THE 21ST CORPS AREA IN 1918.

BY COLONEL E. P. SEWELL, C.M.G., D.S.O.
Royal Army Medical Corps.
AND
BREVET MAJOR A. S. M. MACGREGOR, O.B.E.
Royal Army Medical Corps (T.F.).

I.—PRELIMINARY.

AFTER the capture of Gaza on November 7, 1917, the 21st Corps advanced as far as the line of the River Auja, where it came to a temporary halt towards the end of November. Previous to this advance the amount of malaria in the Corps had been almost negligible, and primary infections practically non-existent.

On November 24 the 161st Infantry Brigade of the 54th Division reached the Summeil and Sarona area, a little distance south of the mouth of the River Auja, which was the first perennial stream that the troops had seen since leaving the banks of the Nile. On December 9 and subsequent days several deaths of men of this Brigade occurred in hospital, and on post-mortem examination these proved to have been caused by subtertian malaria. The blood of a series of men of this Brigade, sick in hospital, was examined and several men were found to be infected with malarial parasites, chiefly of the subtertian variety. In the meantime the 161st Brigade had left the Sarona area and had been relieved by the 156th Brigade of the 52nd Division, which also became infected with malaria.

The following table gives the number of cases of malaria notified weekly in these two Infantry Brigades.

INCIDENCE IN THE TWO INFANTRY BRIGADES WHICH OCCUPIED SUCCESSIVELY THE SUMMEIL AREA.

	December				January					February					March				
	15	22	29		5	12	19	26		2	9	16	23		2	9	16	23	30
(1) 161st Bde. ..	3	6	17	..	20	8	5	5	..	6	3	1	1	..	2	1	—	2	4
(2) 156th Bde. ..	3	—	—	..	15	18	8	1	..	5	—	2	3	..	15	—	2	4	5
	6	6	17	..	35	26	13	6	..	11	3	3	4	..	17	1	2	6	9

(1) Summeil area November 24 to December 17.
(2) Summeil area December 7 to December 22.

The two Brigades occupied successively the area round Summeil, a district covered with orange groves and provided with numerous wells for domestic purposes and irrigation of the orange trees. At the same time the other units of the 52nd and 54th Divisions were scattered over open ground near the river and marshes to the east and south. A few, however, were located near orange groves and wells in the vicinity of the villages of Selmeh and Yasur, and here too a few cases of malaria occurred.

The influence of the Summeil area on the health of the troops who occupied it is well shown by the following chart, which gives the number of cases of malaria notified in each Brigade of the 52nd Division.

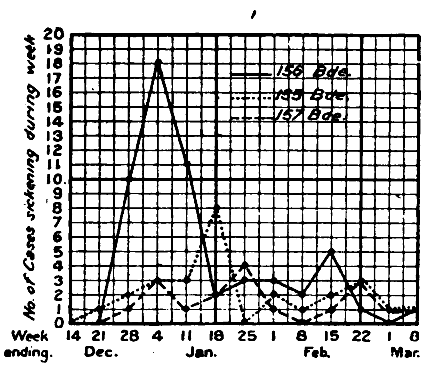


CHART 1.

Moreover the units which occupied the portion of the area where wells were most numerous suffered more than others, who were camped farther away. And to go further still, the incidence of malaria fell almost exclusively on men who lived in billets near the mouths of wells. Thirty-three per cent of the cases occurring at this period in these two Divisions were subtertian malaria.

A mosquito survey of the country was therefore begun on January 5, 1918, by Major E. E. Austen, D.S.O., member of the Sanitary Inspection Committee and Dipterologist at the British Museum. The result of this survey was exceedingly interesting as it was discovered that: (1) Anopheline mosquitoes were breeding neither in the swamps and marshes which exist in the neighbourhood, nor in the River Auja or its backwaters,

nor in small trickles of water running into it, some of which were typical breeding places for anophelines; (2) a species of anopheles, subsequently identified as *Anopheles bifurcatus*, was breeding freely in a large number of the wells which abound in the area, for the supply of water to the orange groves; and to a lesser extent in the open cisterns from which the orange groves are irrigated; (3) adult anophelines were sheltering in the wells, and when disturbed left their hiding places, and bit freely even in

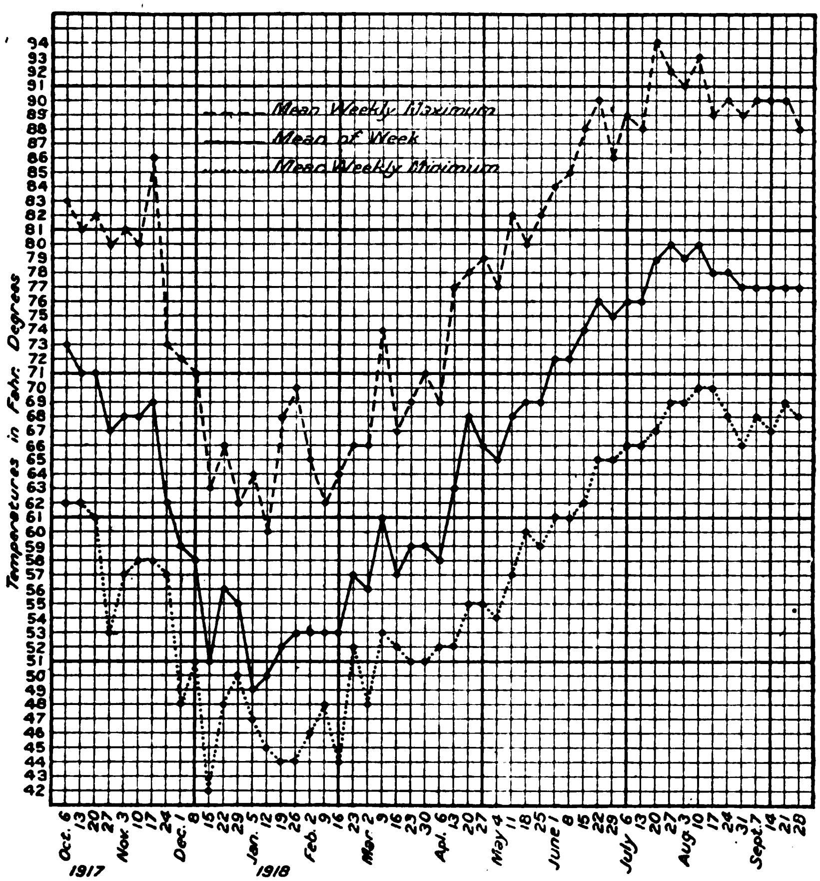


CHART 2.

the daytime in bright sunlight; (4) in 108 wells out of 550 found in this area anopheline larvæ were present. These facts pointed strongly to the probability that the mosquitoes which were carrying malarial infection were those breeding in the wells, and this probability was borne out by the fact that the troops which suffered from malaria were those which had been billeted among the orange groves of Summeil and not those which had lived nearer the river and marshes. The temperature conditions are given in Chart 2.

An active campaign was therefore inaugurated against mosquito breeding in wells. The whole Corps area was divided up into divisional areas, and divisional areas subdivided into smaller areas which were each placed in charge of a medical officer with a party of men from a field ambulance. Each of these parties sought for wells and cisterns in their area, and having found them made a record of each, and treated them with kerosine oil at ten-day intervals. The oil was applied with a "Vermorel" sprayer, half an ounce being used for each square yard of surface. Some of the wells were sixty feet deep, but in most cases an iron ladder reached down to the surface of the water, so that it was possible for the oil to be applied at the surface. These measures seem to have been effective as malarial infections soon became a negligible cause of sickness, and continued so until the early summer.

On April 15, 1918, the condition of affairs in France reacted on the campaign, and the offensive which had been planned was abandoned. It now became evident that the 21st Corps would remain in the area which it was occupying, for the summer months at least. The prevention of malaria immediately became the most important problem. The season was already well advanced, and there was no time to be lost. It was realized at once that the Corps was situated in one of the most malarious parts of a country notorious for malaria. To anyone familiar with tropical countries and accustomed to deal with malarial problems, one glance at the country was sufficient to indicate that the danger was serious, and that nothing short of the most extensive works could save the Army from being decimated by malaria. A more fertile breeding ground for anopheline mosquitoes could scarcely be imagined. Marshes abounded, and numerous streams overgrown with weeds and almost concealed by overhanging undergrowth formed series of pools and sluggish trickles throughout the area. Certain of these marshes and streams already had a bad reputation, and it was significant that in the Auja Valley few dwelling houses were situated, although the orange groves provided work for a number of persons. It was evident that experience of malaria had taught the natives to live on high ground at a distance from their work and from the swamps and streams. A well-known native of the country related that the first Jews who endeavoured to form the colony of Petah Tikweh (near Mulebbis), some forty years ago, were so decimated by malaria that they had to give it up in despair. Their successors, avoiding the lower ground which had proved so disastrous, founded the colony on high ground, well away from the rivers and escaped malaria to a large extent.

Another Jewish colony, Sarona, also had a bad reputation for malaria. The neighbourhood of the great marsh—the Bahret Katurieh—had also an evil reputation. The natives stated that they all left the vicinity of this marsh in the spring. To stay there for the summer meant certain death.

Thus, there is a good deal of evidence that the area occupied by the

Corps was highly malarious, and, if any confirmation were needed, it was supplied on April 12 by the discovery of young anopheline larvæ in the Wadi Abu Lejja. Careful search had constantly been made previously, but it was not until this date that any breeding had been discovered in open water.

The evidence was now complete, and no time was wasted in starting the machinery for an extensive anti-malaria campaign. On the same day that the decision was communicated that the advance would not take place, a survey of the whole area was put in hand, and in a few days drainage works were commenced under the direction of the Chief Engineer, Brigadier-General R. P. T. Hawkesley, C.M.G., D.S.O., R.E., who took a very lively interest in the scheme, and put the whole of the labour at his disposal on to the work, as long as it was required. To his assistance and energy the success of the operations is very largely due.

II.—Physical Features of the Country. (See attached map of the area.)

The line which the 21st Corps held on April 15 was twenty-five miles long, and ran from Arsuf, on the coast, in a south-easterly direction to Ferrekhiyeh, on the River Auja. Thence it followed the Auja to Ras el Ain. From here it ran due east into the foothills about two miles north of Mejdel Yaba, and then ran roughly parallel to and about two miles north of the Wadi Ballut as far as Barukin, where contact was made with the 20th Corps. On May 29 the left of the line advanced 2,000 yards, and on June 8 another small advance was made on the extreme left. Otherwise the line remained the same until September 19, when the great advance commenced.

The area for which the 21st Corps was responsible stretched back to the Jaffa-Ramleh Light Railway, about ten miles behind the lines. There were thus 250 square miles of country which had to be examined and watched for mosquito-breeding. The back areas, however, gave little trouble, as they were waterless except for a few wells.

The area may roughly be divided into three distinct parts, which differ from each other widely in their physical characters. These divisions may be called (1) the coastal area, (2) the valley area, (3) the hill country.

The Coastal Area has an average breadth of eight miles. Walking inland from the shore north of the Auja, one crosses half a mile or more of sand dunes, then descends into a narrow valley, half a mile to a mile in width, climbs a limestone ridge whose average height is about 100 feet, and then emerges on a tract of undulating downs covered with short grass, which extend to the edge of the area and form the western boundary of the Valley of Sharon.

The area is for the most part waterless, but two considerable marshes were formed by the winter rains, and offered ideal breeding-grounds for mosquitoes.

The smaller of these, the Burak Leil, lay about three miles north of the River Auja in the shallow valley between the sand dunes and the limestone ridge. It was divided into two portions; the northern portion measured 700 yards by 200 yards, and the southern portion 300 yards by 100 yards. The depth varied from ten to twelve inches, and the whole area was overgrown with reeds. There were no fish, but tadpoles were present in enormous numbers.

The larger marsh, the Bahret Katurieh, deserved to be called a mere or jhil perhaps rather than a marsh, as the water was two feet deep and was probably perennial. It covered an area of 155 acres, the centre portion of which was open water, while the remainder was covered by sparsely-growing reeds. The edges were clean, and there was little or no weed. It was therefore not an ideal place for mosquito-breeding to all appearances, but later it became infested with swarms of anopheles. The source of these swarms of mosquitoes was somewhat of a mystery, as Major Austen and ourselves had spent many hours examining the edge of the jhil and wading out into the deeper water searching for larvæ, and never had we found a single anopheline larva, although a few culicine larvæ were occasionally seen. A few anopheline larvæ were, however, discovered by the 7th Division in the southern end of the jhil, but the few larvæ discovered could not account for the immense swarms which appeared in the end of May. The whole neighbourhood was searched for other breeding places in vain. It was known that there were extensive marshes behind the Turkish position, and there was a suggestion that the mosquitoes came from there; but the probability was that these first swarms were composed of adults which had hibernated, as described later. This mere or jhil was separated from the sea by the limestone ridge mentioned above, as well as by the sand dunes, and at first sight the problem of draining it appeared well-nigh hopeless; but fortunately an ancient tunnel was discovered perforating the ridge and leading out into the valley between the ridge and the sand dunes. This tunnel was 150 yards long, and was partially blocked with debris fallen from the roof; it was found to be below the level of the marsh, and was evidently a relic of some old civilization which had utilized the waters of the marsh for irrigating crops in the valley. After many years of disuse, it was found useful for a new purpose. The remainder of the coastal area was waterless.

The Valley Area.—This comprised two portions: (1) the Valley of Sharon, a level plain, some three or four miles wide, lying between the coastal area and the hills; (2) the valley of the River Auja, a broad, shallow valley, through which the river meanders, connecting the Valley of Sharon with the sea.

The Valley of Sharon was dry except for the River Auja and its tributaries. In the valley of the Auja, besides the river itself, there was one very important marsh, known as the Abu Zeitun Marsh. This was roughly two miles long by half a mile wide. It consisted of a tortuous,

slowly-flowing stream, which spread out in places into shallow pools. On either side of the stream was a wide belt of soft, spongy soil on which rushes grew plentifully. The soil was so soft that it shook violently when anyone walked over it, and there was an imminent danger of an adventurous explorer being engulfed in liquid mud. In parts, when channels were cut, mud flowed in and soon filled them up. In other parts the ground was firmer, and channels remained open. At the upper end, several acres of peat land were discovered, which was eventually made good use of as a source of fuel. The water in the stream was fed by numerous scattered perennial springs near Mulebbis, and flowed steadily throughout the dry season. This marsh was plainly a fine nursery for anophelines, and its treatment taxed all the engineering and sanitary resources of the Corps.

The River Auja and its Tributaries.—The River Auja is a very remarkable river. One of the few perennial streams in Palestine, it takes its origin from innumerable springs around the old Crusader's castle called Ras el Ain (Head of the Springs). In a few hundred yards the river attains almost to its full size, and thence pursues an exceedingly tortuous course to the sea. The river, which is about the same size as the Wey or the Cam above Cambridge, has a rapid current, and contains water of crystal clearness. From Ras el Ain to a little below Ferrekhiyeh the banks were heavily overgrown with willows, canes, bananas and reeds, and in places the dense tangle of scrub jungle rendered it almost impossible to reach the water's edge. Lower down its course became less tortuous, and the banks grass-clad and almost free from undergrowth.

The distance from Ras el Ain to the mouth of the river is only 9½ miles, but owing to the windings of the river its actual course is about fifteen miles. From the source to Ferrekhiyeh Bridge the distance direct is only about 5,000 yards but the actual measurement along the banks is nearer 10,000 yards. Along this upper portion of the river numerous rivulets draining little marshes join the main stream, and, as one approaches Ras el Ain, these become more and more numerous, until round the Castle itself springs bubble up in all directions and form several acres of swampy ground. Ras el Ain itself was one of our outposts, and was frequently under shell fire, which did not make anti-malaria work any easier.

In the course of the river are three mills, where weirs stretch from bank to bank and backwaters are formed, in which good breeding grounds for anophelines existed among the reeds and undergrowth which overhung the water. These mills are at Mill Race, Hadrah and Jerisheh.

The upper portion of the river with its swamps and overhanging scrub afforded ideal breeding places, but the lower portion (except in a few places and at the mills) did not present the same opportunities.

Several tributaries fall into the river and these were of more importance even than the river itself, as they afforded still better facilities for the hatching out of anophelines.

The most important of these were the Nahr Barideh and Wadi Abu

Lejja on the south bank, and the Wadis Ishkar, Dhaheb and Rabah on the north bank. These tributaries consisted for the most part of stagnant pools connected together by stretches of swamp, the whole overgrown by a tangled mass of scrub. The Nahr Barideh has a total length of many miles, but only the lower four miles contained water during the early summer, and the lower 1½ miles of this had a similar character to the lower reaches of the River Auja. There were thus 2½ miles of its length which had the characteristics described above, so eminently suitable for breeding.

The Wadi Abu Lejja presented 7,000 yards of alternate pools and swamps, the whole densely overgrown with an impenetrable tangle of trees, brushwood and canes, which rendered passage along its course impossible.

The wadis on the north bank had similar characteristics and had the additional disadvantage of running out of our lines across "No man's land" into the enemy's lines. The enemy could not be relied on either to do his share of the work or to refrain from interfering with our efforts in "No man's land."

It was quite evident to anyone with tropical experience that we had in the Auja system conditions eminently suitable for the breeding of immense numbers of anopheline mosquitoes, and that these mosquitoes would soon become infected with the malaria parasite and spread the disease.

Although the local inhabitants had been cleared out of the forward areas, many of the troops had served in malarious countries previously, and relapsing cases were fairly common in all divisions. The sources of infection could not therefore be entirely eliminated, and subsequent events tended to show that the earliest mosquitoes were already infected, as outbreaks of malaria followed fourteen to sixteen days after the first appearance of anophelines. Whether these mosquitoes were those which had hibernated in sheltered spots throughout the winter or newly hatched mosquitoes there is no evidence to determine, but as they appeared in great swarms before much breeding had been discovered, the former alternative appears more probable.

The situation was one which we viewed with much apprehension. There was, indeed, some doubt as to whether mosquitoes would breed in the rushing waters of the main river, but no doubt could exist as to the suitability for breeding purposes of the marshes, swamps and pools in which the area abounded. Two alternatives presented themselves to the responsible authorities: to evacuate the dangerous zone and retire to the hills behind Mulebbis, or to embark on a tremendous experiment in the nature of one of the biggest anti-malaria schemes ever executed. Complete success could not, of course, be guaranteed, but we considered it not too optimistic to anticipate that as a result of the very extensive works proposed, malaria would at least be kept within reasonable bounds. The ultimate decision rested, of course, with the Corps Commander, who after

hearing both sides of the question, decided to remain on the line the Corps then occupied, as the tactical situation would be considerably weakened by a retirement. This decision was finally arrived at on May 24, and we were definitely committed to the extensive scheme which will be described.

The Hill Country was not a serious problem; mosquito breeding places in this area were confined to the underground rainwater cisterns, which existed in large numbers in all the villages, and to a few springs which burst out of the hillsides in certain places, forming small pools and swamps. Anopheline larvæ were found breeding in these places at an early date, and simple measures of canalization and drainage were adopted, which confined the water to single channels, and destroyed the breeding places. Constant attention was required throughout the whole season to keep the channels clear and free from weeds, cisterns which were not required were closed, and others kept under close supervision. Otherwise the anti-malaria work in this section requies no comment.

The area occupied by the Corps was divided up into Divisional Areas as follows:—

The 7th (Meerut) Division held the line from the sea to Ferrekhiyeh, and the area for which it was responsible stretched back to the Auja river, and included the Nahr el Barideh. The 54th Division held the portion of the line between Ferrekhiyeh and the foothills near Mejdel Yaba, and the area under its administration stretched back to the Sarona-Ludd Light Railway, and included the Abu Zeitun Marsh. The front portion of this area was taken over by the 3rd (Lahore) Division when it relieved the 54th Division at the end of June. The 75th Division held the remainder of the line from near Mejdel Yaba to Berukin.

III.—Notes on Mosquitoes found in this Area, and their Breeding Places.

The larvæ of *A. bifurcatus* could be found in wells throughout the winter months, but no breeding was discovered in open waters in spite of constant observation until April 10, when young anopheline larvæ were discovered in the Wadi Abu Lejja. During the remainder of April, the River Auja, and the marshes Bahret Katurieh, Burak Leil and Abu Zeitun, were carefully searched by Major Austen and ourselves. No larvæ were discovered in the marshes, but a few young anophelines were found in springs running into the river near Ras el Ain on April 26.

On May 3, larvæ of *A. sinensis* and *A. algeriensis* were found in the Abu Zeitun marsh, and from then onwards they could always be found until the drainage operations were completed.

On May 14, larvæ of *A. palestinensis* were found in springs and swampy places up the Wadi Ballut, and on May 17 in a small spring running into the River Auja near its mouth.

On May 26 young anopheline larvæ were found fairly commonly among

rushes along the banks of the River Auja between Ras el Ain and El Mirr, and in its tributaries, and from this time onwards they became more and more common until the clearing work was completed.

It is evident from these observations that breeding in the open does not begin until early in April, and is not very common until the end of the month. During May, breeding is progressing freely over the whole area.

The following species of anopheles were found in the area :—

A. bifurcatus.—Adults and larvæ found during the winter and spring in wells and cisterns.

A. palestinensis.—Larvæ common in May and June in running water from the springs up the Wadi Ballut and on the banks of the Auja.

A. mauritianus.—Common in May and June in natural waters around the Auja.

A. maculipennis.—Adults appeared in swarms in the early days of June on the edge of the Bahret Katurieh, and a few larvæ were found in the same marsh. Later in June as the marsh dried up under the influence of the drainage operations, large numbers of larvæ were found.

Larvæ of *A. maculipennis* were also found in the Nahr Barideh and wadis on the north of the River Auja, also in backwaters of the River Auja at Hadrah and Jerisheh.

A. sinensis was fairly common in June and was found chiefly in Abu Zeitun marsh and backwaters of the river.

A. algeriensis was never common. It was found chiefly in Abu Zeitun marsh in May and June.

One specimen of *A. pharoensis* was reported from the coastal area, but this was not confirmed.

IV.—The Anti-Malaria Campaign.

On April 15, 1918, it was decided that measures must be taken at once to deal with some of the worst features, and the Chief Engineer was requested to report on the drainage and canalization of the marshes and rivers in the area. The following measures were recommended to Corps headquarters :—

(1) The drainage of marshes and canalization of streams.

(2) The trimming of the banks of the Auja and removal of reeds.

(3) The oiling or closing of wells and cisterns.

(4) Avoidance by troops of the neighbourhood of rivers, marshes and streams as far as tactical requirements would permit.

(5) Protection of men by mosquito-proof huts in the most dangerous places, and by nets elsewhere.

(6) Use of a repellant ointment and head-nets for men exposed on duty at night.

(7) Avoidance of villages by at least half a mile, or removal of native population.

(8) Evacuation and thorough quininization of soldiers infected with malaria.

The object of these recommendations was to attempt to protect the troops against malaria by the three well known lines of defence, namely, (i) by removing the reservoir of infection in the persons of infected soldiers and potentially infected natives; (ii) by destroying the carrier of infection, and (iii) by protecting individuals against infection by bites of anopheline mosquitoes. It was recognized that the complete success of any one of these measures was too much to expect. To discover and eliminate all malaria carriers in a force largely composed of Indians and of troops which had been serving previously in malarious countries was not possible. The destruction of all anopheline larvæ in an area so ideally suitable for breeding was beyond our wildest dreams. Knowing the careless and happy-go-lucky ways of Thomas Atkins and his officers, we could not delude ourselves into the belief that nets or huts would be used properly, head nets kept on, or mosquito-repellant grease employed regularly. We entered on this campaign, therefore, with no hope of complete success, but with a certain amount of trepidation, as a complete failure would have consequences we hardly dare contemplate. Here we had an army of over 50,000 men deliberately camping in one of the most highly malarious areas which could well be found, and proposing to stay there throughout the worst months of the year. If extensive anti-malarial works were not carried ont, the extinction of the Army as a force would be the probable result of occupying such an area. Could we say that the proposed works, if carried out, would render the district so much healthier that such a catastrophe would not occur? We thought we could at least guarantee such a measure of success as would justify the labour involved, and would keep malaria within reasonable bounds. The results, although not perhaps so good as we hoped for in our most sanguine moments, justified us, we think, in entering into the scheme.

One fact, which militated strongly against a more complete success, was the fact that the season was well forward when the work was begun. Had engineering operations been commenced and finished a month earlier, the first brood of mosquitoes, which must be regarded as the most important of all, would not have come to maturity. As it was, both in the Bahret Katurieh and in the upper waters of the River Auja, we were too late to stop the hatching out of this first brood, and malaria commenced to become prevalent immediately afterwards. The delay in starting the work, as already mentioned, was due to the fact that extensive military operations were proposed, and abandoned only at the last moment. These operations would have carried us far out of the zone now under discussion.

Another factor which undoubtedly militated against success was the impossibility of controlling the breeding places in "No Man's Land" and in the enemy's lines. Working parties went out frequently at night beyond the front line and cleared and oiled pools almost up to the enemy's wire,

but no doubt much breeding went on between the lines. Behind the enemy's lines large marshes existed, which to a certainty bred numerous mosquitoes. But it may be considered that such mosquitoes found plenty of food close at hand in the persons of the Turks, and did not cross the lines to any great extent.

The anti-malaria measures taken may be divided into (A) General measures; (B) Engineering measures.

(A) *General Measures.*

These consisted of mosquito-proof huts, mosquito nets, mosquito repellant grease, evacuation of all natives, siting of camps, oiling of wells and cisterns, and efficient treatment of infected soldiers. To these may be added the institution by General Headquarters of malaria diagnosis stations. These stations, of which two were allotted to the 21st Corps, consisted of a specially trained medical officer and three orderlies, equipped each with two microscopes and stains. They were situated in central spots, and blood films of all cases of pyrexia were sent to them for early diagnosis. In this way the blood was examined before quinine was given, a diagnosis was arrived at, and effective treatment was commenced with the minimum of delay. They proved of the greatest value, and rendered much assistance in keeping a check on the incidence of malaria.

Mosquito-proof huts, for want of better material, were made of sheets of Hessian on wooden frames. For purposes of concealment they were usually made small and held three men, though a few larger huts were tried in some places.

They all proved absolutely useless, as the Hessian soon got torn, the frames warped, and the ground became worn away under the doors, so that a large opening was left between the door-frame and the ground.

Mosquito-nets were made to fit inside bivouac sheets. One net was shared by two men. Unfortunately these nets were not available at the beginning of the mosquito season. Constant supervision was required to insure that the men used the nets properly, but, when used with care, they were, no doubt, of considerable value.

Mosquito repellant grease was also late in arriving from England. Its composition was as follows:—

Oil of cassia	1 part
Brown oil of camphor	2 parts
Vaseline or lanoline	3 parts

This ointment was fairly efficacious in keeping off mosquitoes, if used in sufficient quantities. But its influence appeared to wear off in about five hours. It did not seem to have any repellant effect on sandflies.

Oxford grease and vermijelli were also tried. The former is a thick, black greasy preparation and finds no favour with the men. The latter is not unpleasant to use and undoubtedly keeps off mosquitoes and sandflies.

Natives were all evacuated from the forward area. The troops were

camped as far as possible on high ground away from the dangerous areas, only the minimum number of men necessary for holding the posts being located in the malaria zone.

Oiling of cisterns and wells was continued throughout the season, and when the irrigation of orange groves was started, careful watch was kept to discover and to put a stop to mosquito breeding at its earliest appearance.

Lectures were given in each Division by specially selected medical officers to officers and men on the subject of mosquitoes and their relation to malaria, and opportunities were taken to interest all ranks from the highest downwards in the subject.

The question of the prophylactic use of quinine was raised and discussed at a conference of A.D.M.S.s of the Divisions, all of whom had had many years' experience of malaria in India. Not one of them, nor we ourselves, were in favour of its use prophylactically, and it was never employed. It was recognized, however, that the effective treatment of malaria was a matter of the first importance, not only as regards the individual, but also as having a most direct bearing on prophylaxis. For this reason it seemed desirable that all men infected with malaria should be evacuated to the base hospitals in order that a thorough course of quinine might be undergone. Malaria registers were kept in each unit, and all men who had an attack of malaria were entered in the register and were kept under quinine treatment for three months, receiving ten grains a day after leaving hospital. In spite of this the number of relapsing cases was high, and tended largely to swell the total figures.

(B) *Engineering Measures.*

No time was lost by the Chief Engineer in putting the work in hand, and the canalization of the Nahr Barideh and Wadi Abu Lejja was commenced at once. There was a slight delay over the drainage of the Bahret Katurieh, as it involved a tactical question and the maintenance of an additional post. When it was pointed out, however, to the Corps Commander that the marsh would become a large breeding ground of anophelines and be an almost certain source of malaria to the troops, he readily sanctioned the scheme and the work was promptly begun.

The various engineering works will now be described in detail and in chronological order.

(1) *The Nahr Barideh.*—The work was commenced on April 18 by the Deputy Director of Works, Jaffa area, with 600 men of the Egyptian Labour Corps, and was completed early in May before any mosquito breeding had begun.

The upper portion for a distance of about two miles and a half consisted of a series of pools at close intervals lying in a deep channel in light, sandy soil. The pools varied in size, the largest measuring about 60 yards in length, 6 yards in breadth, and 10 feet in depth. A channel was dug connecting all the pools together, and then, beginning at the top, the pools

were completely filled in with loose soil from the steep banks. Owing to the absence of springs, this was possible as far as a point a little way above the Barideh Bridge near the German Colony of Sarona. Here there were two very large pools into which several perennial springs flowed. These pools could not therefore be filled in, but their margins were freed from rushes and weeds, and carefully trained. From this point to its junction with the River Auja, a distance of nearly two miles, the stream was canalized and its banks cleared of vegetation and carefully trained. After the work was completed constant maintenance and supervision was required, as algal growths flourished readily in the slow current, and presented breeding places of which mosquitoes were not slow to avail themselves.

In August it became necessary partially to fill in the pools left above the Barideh Bridge and to retrain the remainder, as mosquito-breeding was going on in the more sluggish portions of the stream in spite of every effort to prevent it.

In addition a permanent patrol was necessary for the purpose of channeling and oiling the streamlets which trickled into the river all along its banks. The difficulty of looking after many of these rivulets was diminished by the conversion of a number of them into Irish drains. Although anopheline breeding occurred to some extent during July and August, and was possibly the cause of a certain amount of malaria among Corps troops camped in the neighbourhood (see Chart 3), there is no doubt that very free breeding would have taken place and a serious outbreak of malaria followed if these measures had not been adopted.

(2) *The Wadi Abu Lejja.*—The work on this wadi, which was about 6,000 yards long, was carried out by 1,200 Egyptian labourers working under the supervision of the 14th Army Troops Co. Royal Engineers. It was commenced on April 18th, and finished in the middle of May. The dense growth of vegetation which filled the wadi having first been cut down, a channel of uniform width was made throughout the length of the stream by partially filling up the pools and by cutting a passage between them. When this had been accomplished, and no springs of any importance had been found, it was decided to go further and obliterate the whole stream. This was done by filling in the channel from the top to the bottom, and, although a little seepage of water occurred at various points, this was easily dealt with, and one of the most dangerous breeding places ceased to exist.

(3) *Burak Leil.*—The engineering scheme for dealing with this marsh contemplated pumping the water into the sea over the intervening sand ridge which bounded it on the west side. A large sump was dug just under the ridge into which the water was drained by herring-bone channels cut through the two portions of the marsh. Pumping operations from the sump began on May 14 by means of a steam pump, and four Hayward Tyler sets, capable of delivering 15,000 gallons per hour. Three hundred yards of four-inch piping was used to carry the water over the hill. In

order to aid evaporation, the reeds growing in the marsh were cut simultaneously with the digging of the channels. The marsh was dry by May 27. It was estimated by the engineers that of the 6,000,000 gallons representing the original content of the marsh, 4,800,000 gallons had been pumped out, and that the remainder, 1,200,000 gallons, had evaporated, thus demonstrating the value of reed cutting. This marsh was just finished in time, as young anopheline larvæ were commencing to appear in one or two small pools at the end of May. There is no doubt that the rapid and early drainage of this marsh was a valuable asset to the troops, as it was situated in the middle of the reserve area of the 7th Division and surrounded by troops whom it would have been impossible to locate elsewhere. Sixteen sappers and 330 men of the Egyptian Labour Corps were employed on this work from the middle of April to the end of May.

(4) *The Abu Zeitun Marsh.*—The drainage of this marsh presented considerable engineering difficulties owing to its great length, its slight fall, the spongy nature of the soil, and the perennial springs which fed it. The stream which ran through it only had a fall of nine feet in two miles. The work was commenced by digging a main drain along the course of the stream, and then cutting subsidiary drains on a herring-bone pattern, running into the main channel. The latter measured 14,000 feet in length, and varied from 6 feet to 20 inches in depth, while the branch drains totalled a length of 11,000 feet, and were from 4 feet to 6 inches deep. About one-third of those subsidiary channels eventually dried up either completely or sufficiently to allow of partial filling with sand. At the upper end of the marsh an area of about four acres gave great trouble, as the ground was so waterlogged and soft that the sides of the trenches repeatedly collapsed, or the flow of water was obstructed by the blocking of the channels with liquid mud. However, as the summer advanced, the drying power of the sun, which was facilitated by the removal of all vegetation, gradually took effect, and the surface of the ground became harder. After all the water had been successfully confined to the numerous channels, it was still necessary to carry out systematic oiling of branch drains at weekly intervals.

Up to the middle of June, when the main work was completed, it was estimated that 50,000,000 gallons of water had flowed through the main channel; about 20 acres of reeds had been cut, 8,500 cubic yards of soil had been excavated, and the labour employed (Egyptian Labour Corps) amounted to 15,354 men-days. Regrading the drains occupied a further 100 men for about three weeks. From the beginning of July onwards fifty men were employed on maintenance work only, in addition to oiling parties, and such extra labour as the A.D.M.S. 3rd Division considered necessary from time to time.

The engineering work was carried out by the 14th Army Troops Co. Royal Engineers.

(5) *The Bahret Katurieh.*—The work on this large marsh was started

on April 18. It consisted of clearing and deepening the old tunnel, and constructing channels to the sea and to the marsh from the west and east ends respectively. To obtain the correct level it was necessary to deepen the floor of the tunnel by some ten to fifteen feet, an extensive operation which was aided by the construction of a Decauville railway. Unfortunately the concussion of heavy guns on May 27 caused the collapse of the western end of the tunnel, as the result of which not only had a large amount of work to be done over again, but a timbered gallery 160 feet long had to be constructed to support the roof. The channel which was dug from the tunnel to the sea was 1¼ miles long with an average width of six feet.

On June 12 the system was completed, and water began to discharge from the marsh at the rate of 90,000 gallons an hour. As the level of the water subsided, herring-bone channels were dug in the marsh by working parties in full view of the enemy, who every now and then put a few shells over. At the same time sedges were cut over a wide area to encourage evaporation, and by July 13 the whole marsh was completely dry. But unfortunately this was too late to prevent the hatching out of large numbers of anopheline mosquitoes, which caused outbreaks of malaria among troops stationed in the neighbourhood.

An interesting point connected with this locality is that early in June, when swarms of *A. maculipennis* suddenly appeared in the neighbourhood of the marsh at a time when little or no breeding was discoverable, large numbers of the adults of these species were found harbouring in the tunnel. There were also swarms of culicines in the tunnel, but it was noticed that the culicines occupied the positions near the end of the tunnel while the anophelines occupied the central part. There seemed a strong probability that these mosquitoes had hibernated in the tunnel during the winter, and that the first swarms which appeared were composed of individuals which had hibernated there and in the caves which abound in the district. Two cylinders of chlorine gas were discharged into the windward end of the tunnel, and very few mosquitoes survived. Other victims of the gas were numbers of frogs, snakes and birds.

Anophelines remained plentiful in this area during June, but in July their numbers diminished until at the end of the month few were left.

This valuable and difficult engineering work was carried out by a company of Indian sappers and miners under the C.R.E., 7th Indian Division.

(To be continued.)

FATIGUE-CURVES AS A METHOD OF ESTIMATING NERVE ENERGY.

By Major T. W. GORDON KELLY.
Royal Army Medical Corps.
Medical Officer in Charge, Desford Auxiliary Military Hospital.

Can we illustrate, in terms of resistance to fatigue, the increase of nerve energy which is often apparent after prolonged "feeding-up" of the nervous system?

The phrase nerve energy may be more convenient than scientific, but for all practical purposes its meaning is sufficiently clear. We know when our patient is losing or gaining energy as we know when he is losing or gaining weight. But the one can be accurately measured; for the other we depend chiefly on clinical observation. Under normal conditions that may suffice, but in dealing with a multitude of soldier-patients, most of whom suffered from severe nervous exhaustion in addition to their other symptoms, I early felt the need of some physiological test for determining to what extent the nervous system was being energized, so to speak, by nutritive treatment intended to produce that effect.

My interest in the subject was roused some years ago by Tunnicliffe's metabolism experiments, showing the marked increase in the retention of phosphorus as well as of nitrogen in the body after the administration of casein-sodium glycerophosphate. Mann subsequently demonstrated, by microscopic examination of the nerve cells of frogs, the visible indications of heightened vitality in the ependyma cells of the central canal of the spinal cord and in the small nerve cells of the mid-brain after feeding with the same substance. We thus have proof that the glycerophosphates, when administered in the organic state, are in fact absorbed and utilized by the body, as theoretically we should expect them to be; and, if Mann's results hold good of human subjects, we are also justified in assuming that this mode of nerve-nutrition is followed, as he says, by "a building-up process in the nerves" manifested by increased energy. But the ultimate criterion of such increased energy must surely lie in the patient's power to *expend* energy in the form of muscular power. Calorimetry is of course the classic method of estimating this, and in the hands of workers like Rubner and Zuntz, and more recently of Atwater, Benedict and Lusk, it has certainly yielded wonderful results. Its difficulties, however, are formidable, necessitating the use of very complicated and costly apparatus, and most investigators in this country have therefore confined themselves to the easier and simpler methods of indirect calorimetry, which in my opinion are not so satisfactory. Besides, investigation along these lines requires that the subject should engage in more or less vigorous manual labour to accelerate his respiration, which was not desirable for my

patients. As already indicated, my purpose was to illustrate graphically their gain in nerve energy by their degree of fatigue-resistance in performing some simple, non-strenuous work, where the exhaustion-point could be reached without undue strain to the organism. Mosso's celebrated work on "Fatigue" gave me the hint I needed, and I was fortunate enough to secure the loan of an ergograph, his very ingenious laboratory device for measuring and recording the subject's capability for work by the weight he can continue to lift with the middle finger.

Description of the Apparatus.

As the ergograph is not so well known in this country as it should be, I give in fig. 1 an illustration of it, reproduced from a photograph. In manipulating the apparatus the hand and forearm are placed with the

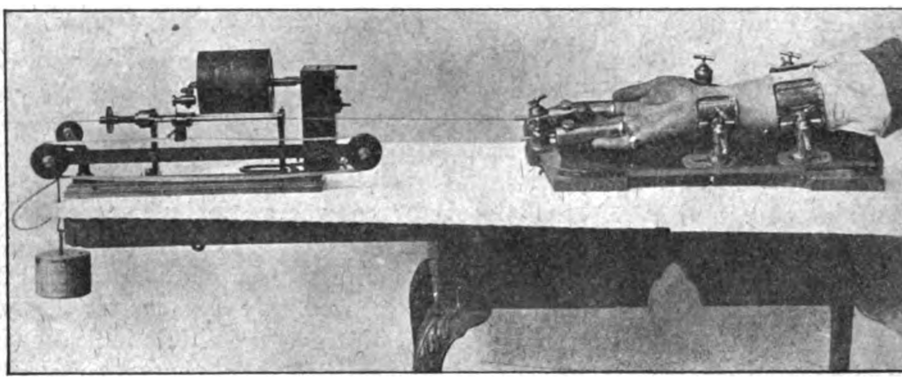


Fig. 1.

dorsal aspect on cushioned supports, the wrist is encircled and clamped, and the index and ring fingers are introduced into hollow tubes, leaving free the middle finger, to which is attached a leather loop and cord passing over a metal pulley and suspending a weight of four kilogrammes. The registering apparatus consists of a clockwork cylinder, slowly revolving at a uniform rate and covered with smoked paper on which a recording stylet traces every contraction of the middle finger as the subject raises and lowers the weight until exhaustion compels him to desist. We thus see the number of contractions in a given period, while the height of the curves—which gradually or suddenly diminishes—and their relative "force" or feebleness, show the varying degrees of energy expended in raising the weight against the pull of gravity.

Results of Observations with the Instrument.

With this instrument I have obtained numerous tracings and experimented with various types of patient, and I propose to give five cases

(with clinical notes) which are typical of the collected material. After allowing for the personal factor inseparable from all ergograms registered with Mosso's apparatus, I consider that the results obtained definitely fulfil the purpose for which my experiments were made—viz., to place on record graphic evidence of the patient's gain in nerve energy, as shown by his increased capacity to do a given amount of work without premature

FIG. 2.

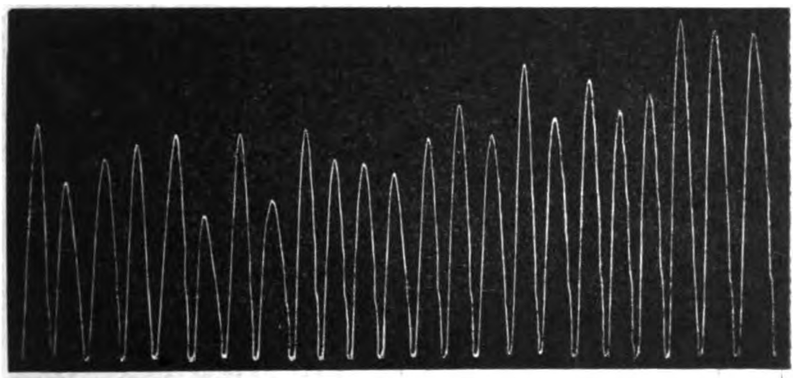


FIG. 3.

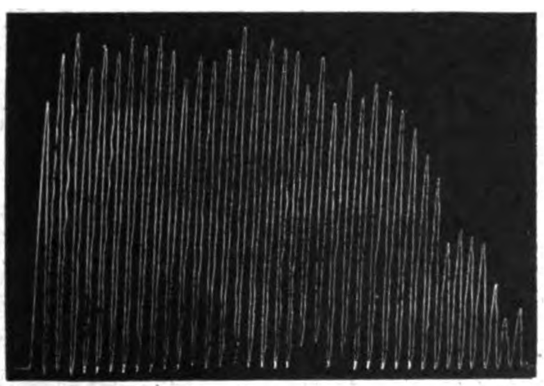


FIG. 4.

Fig. 5.

or abnormal fatigue, after the addition of casein-sodium glycerophosphate to his ordinary diet for an extended period. I chose sanatogen, which was also used in both Tunnicliffe's and Mann's experiments, as being the most reliable preparation for my purpose and one that had always given me the most satisfactory results during many years' clinical experience with it.

ILLUSTRATIVE CASES.

(1) Serjt. J., aged 53. *Suffering from after-effects of trench fever and considerable nervous debility*, due to the strain and exhaustion of three and a half years' service in France, from August, 1914, including retreat from Mons. Pain in head and legs; cough, dyspnœa on least exertion, disordered action of heart, very debilitated. Weight, 9 stone 6 pounds. After the first ergogram (fig. 2), taken on January 10, he was given two spoonfuls of sanatogen three times daily. The second ergogram (fig. 3) was taken a month later, by which time he could walk four miles, the dyspnœa had disappeared, D.A.H. was greatly improved, and he was much more cheerful. On March 28 the third ergogram (fig. 4) was taken. He had then quite recovered. All nervous symptoms had disappeared; his weight had increased to 10 stone 5 pounds, a gain of thirteen pounds in less than two months; he was bright, cheerful and energetic, and acted as my N.C.O. in charge. He was given no medicinal or dietetic treatment other than the sanatogen, and the stages of his exceptional and rapid recovery are well illustrated by his fatigue curves. I cannot resist publishing a final ergogram (fig. 5), taken on April 2, the day prior to his discharge from hospital. Unfortunately he went at a slower rate, and the stylet was imperfectly adjusted to the drum, but the sustained effort and energy shown are exceptional.

(2) Cpl. H., aged 24. *Debility.* Very neurasthenic and run-down. Reflexes exaggerated; slight D.A.H. Weight 10 stone 2 pounds. Sanatogen was commenced immediately after the first ergogram (fig. 6). After

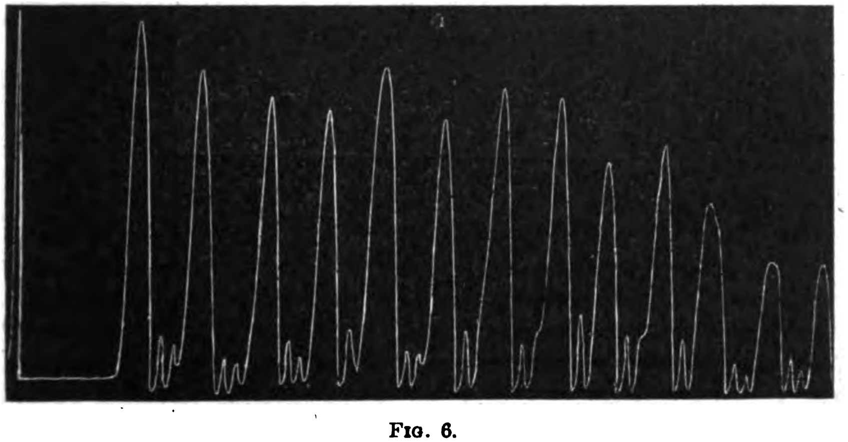


FIG. 6.

three weeks the second (fig. 7) was taken, and there was a marked general improvement in his condition; the nerves were steadier, the heart normal, and he was much more cheerful. The third ergogram (fig. 8), taken a fortnight later, shows the increase of energy in the patient, who by now had completely recovered and gained two pounds in weight.

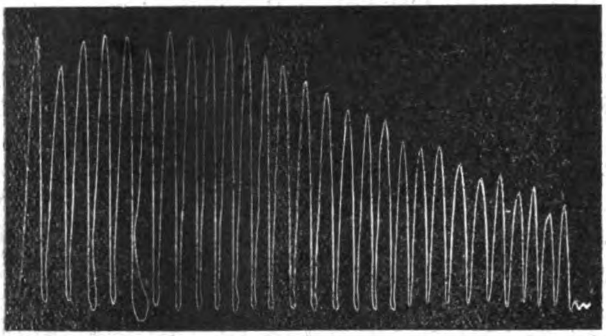


Fig. 7.

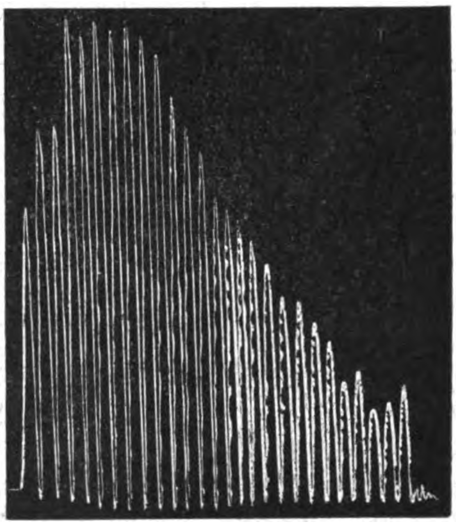


Fig. 8.

(3) Serjt. M., aged 40. *Bronchial catarrh, with signs of pulmonary tuberculosis.* Very debilitated; nutrition and appetite poor; chronic cough; fine crepitations at right apex. Was quite well until a year ago, when the cough commenced and his sputum was bloodstained for some time, though it contained no tubercle bacilli and there were no night sweats. Since then he had been getting thinner and weaker. The first ergogram (fig. 9) is characteristically feeble. The second (fig. 10)

shows considerable improvement, resulting from a month's treatment with sanatogen. His appetite was better, and he looked and felt much stronger. In another month, when the third ergogram was taken (fig. 11) his cough gave little trouble, there was no physical signs at apices, and his general

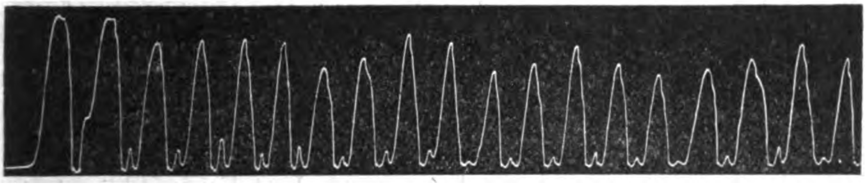


FIG. 9.

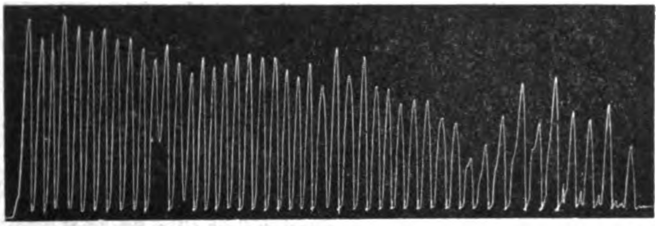


FIG. 10.

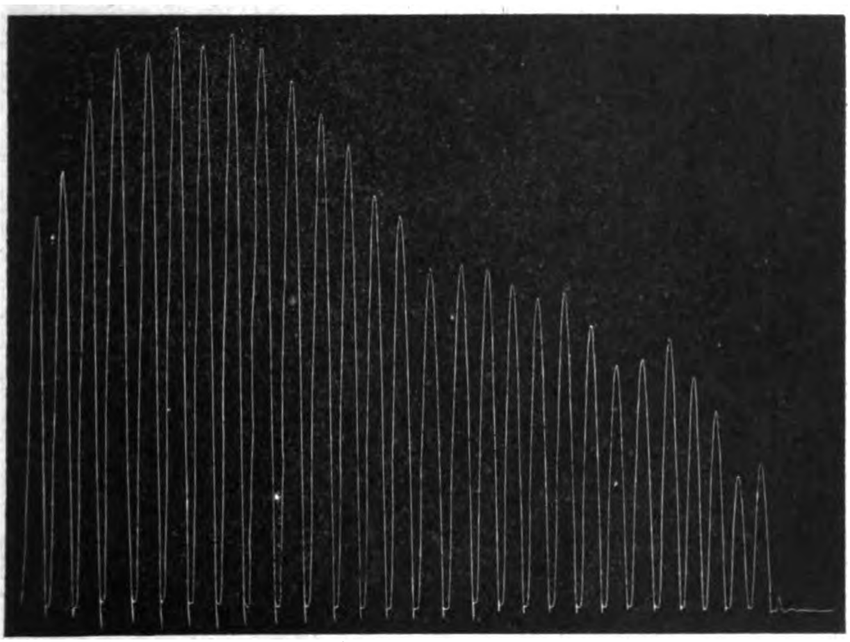


FIG. 11.

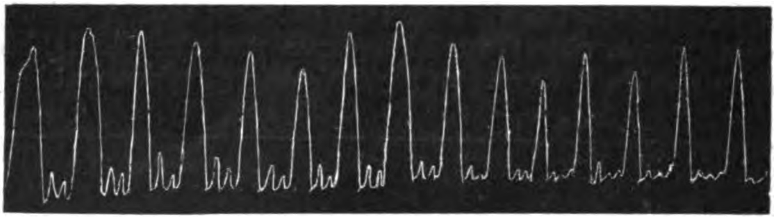


Fig. 12.

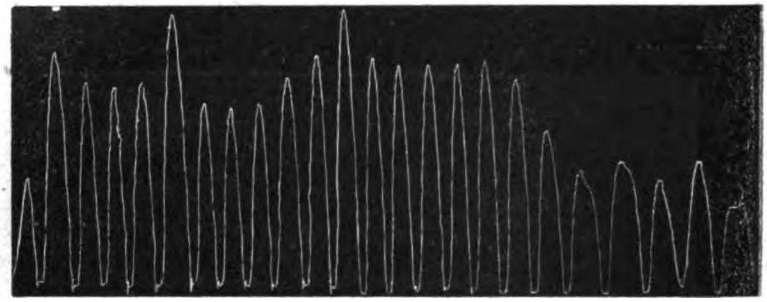


Fig. 13.

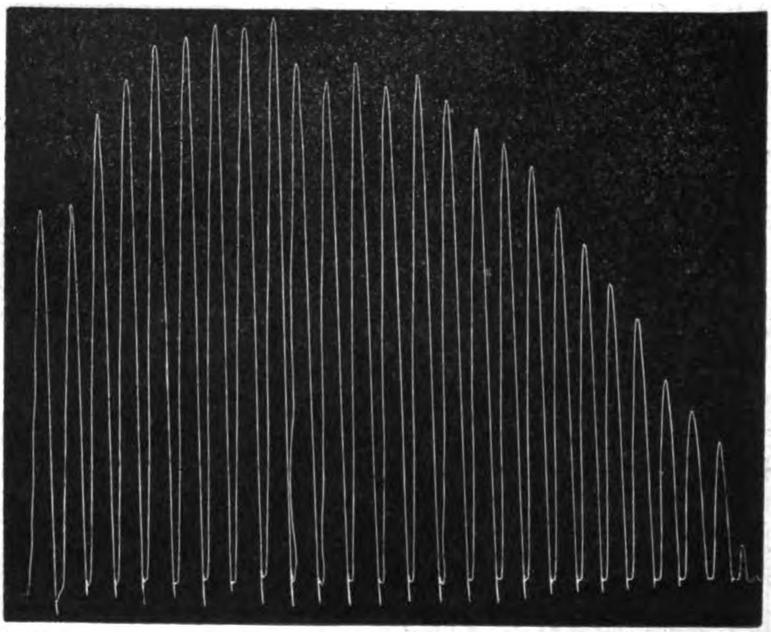


Fig. 14.

health and energy were so much improved that he was able to act as N.C.O. in charge of patients prior to his discharge.

(4) Pte. T., aged 33. *Bronchitis.* Considerably run-down; also evidently suffering from gastritis. Occasional sickness and epigastric pain, increased by food. Chronic insomnia. First ergogram (fig. 12) taken a few days after admission. Began to improve immediately under careful dieting, with sanatogen. A month later the second ergogram was

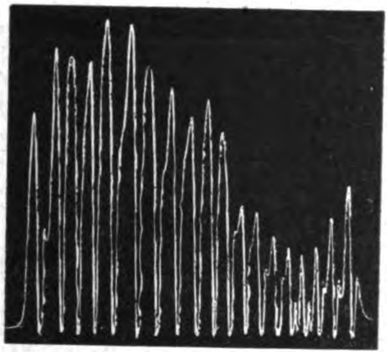


Fig. 15.

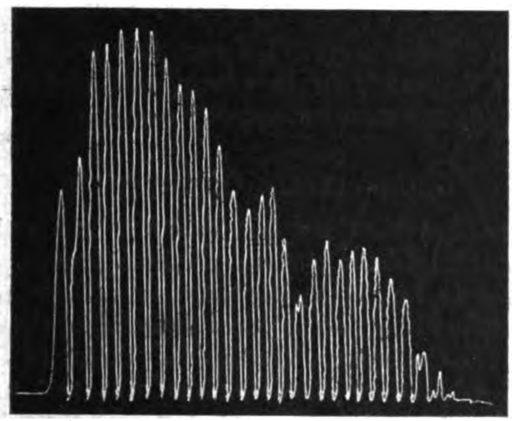


Fig. 16.

taken (fig. 13). He was considerably better, and the sickness and insomnia had disappeared, though there was occasional recurrence of pain after meals. He continued to improve and gain strength, was able to take long walks without fatigue, and was discharged a month later. He had gained nine pounds in weight, and the third ergogram (fig. 14) illustrates a concurrent gain in energy and muscular strength.

(5) Pte C., aged 30. *Convalescent after operation for appendicitis.* Quite recovered from operation, but extremely neurasthenic. Insomnia.

and "frightful dreams." Though a strong young fellow, organically sound, he had a bad attack of neurasthenia some four years ago in civil life, brought on by accidentally shooting himself in the foot. Treatment: encouragement as to no evidence of organic disease; light occupation daily in the garden; sanatogen three times a day. First ergogram March 6 (fig. 15); second, March 27 (fig. 16). Much brighter, and considerable improvement in general condition, but still sleepless at times and troubled with the frightful dreams. The third ergogram (fig. 17) was taken on

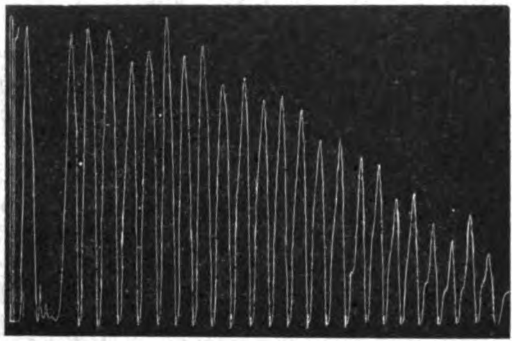


Fig. 17.

April 18, prior to his discharge. He was very much better in every way, and there was a distinct gain in energy and cheerfulness, though the neurasthenic symptoms were not entirely overcome.

Concluding Observations.

It will be noticed that the last case was the only one in which a characteristic mental factor was at all conspicuous. The rest of my patients appeared to be psychically normal. Their nervous exhaustion could be attributed entirely to physical causes, and they recovered without any form of psycho-therapeutic treatment. So far as the nervous system was concerned, what they chiefly needed was rest and nerve-nutrition. But it is significant that the fatigue-curves of Case 5 and his condition when discharged were so much less satisfactory than those of the other cases. Perhaps I should have labelled him psychasthenic rather than neurasthenic. In either case he was hardly a good subject for my experiments, for it was not nerve energy that he lacked so much as mental control—the power to rid himself of the morbid obsession that he was organically diseased; and I daresay he would have benefited by hypnotism, psycho-analysis, or one of the numerous other methods which, in expert hands, have proved so wonderfully successful during the war.

I have referred already to the personal factor which has to be taken into account when investigating fatigue-curves. A strong-willed man,

determined to "break the record," could no doubt force himself to produce an ergogram which would give a quite illusory idea of his normal powers of resistance to fatigue. Possibly the fourth ergogram of Case 1 is open to suspicion on that account, but not any of the others; I saw to it that they did not go beyond what James calls "the first effective layer of fatigue-distress." On the other hand, I was careful not to include possible malingerers amongst my subjects. They were all intelligent men of good character, and the object and meaning of the experiments were fully explained to them, so if they had desired to malinger they would obviously have continued to produce feeble ergograms like their first ones, instead of showing a marked improvement in each test. (Explaining the apparatus to them also deprived it of any power of "suggestion" which it might have exerted had they imagined it to be some mysterious new "cure.")

Every effort was also made to keep the conditions of the experiments as stable as possible. For example, no ergogram was taken at a time when the patient was unusually elated or depressed by the receipt of good or bad news, whether of a public or private character. Not only time and place, but even the state of the weather was taken into account. Some control experiments which I made emphasized the importance of such factors. They are of course psychic factors, and what I aimed at was a purely physiological test.

LARVICIDES.

By Brevet Major J. F. MAYNE.
Royal Army Medical Corps (Territorial Force).

AND

Serjeant W. R. JACKSON.
Royal Army Medical Corps (Territorial Force).

Early in 1918 No. 25 Mobile (Hygiene) Laboratory received orders to proceed to the Struma Valley to conduct an investigation into the effects of certain larvicides on the larvæ of the mosquito, and incidently to

"Meditate the Book
Of Nature, ever open."

Nature's book was always open along the banks of the Struma. The beautiful plumage of the jay, the peaceful flight of the stately stork, the idle flapping of the hawk searching a copse, the huge jaws of the ugly and half-blind solpugid, the diligence of the tireless scarab, the ferocity of the praying-mantis, and a hundred and one other manifestations, constantly reminding us that "in Nature there is nothing melancholy," will not be forgotten readily by those of us who were on active service in Macedonia.

But by night the melodious notes of the nightingale were too often obscured by the hum of the blood-sucking anopheles, or the vicious attacks of the small phlebotomus, Esau-like in its hairiness. It was on these occasions that one disagreed with the poet, for nothing could exceed the "melancholy" of a "sand-fly"-infested night in the Balkans.

Macedonia teemed with insect life, and was a happy hunting ground for the soldier-naturalist, entomologist, or any one who had eyes to see. For such as these the Macedonian wild never lost its charm.

Early in February we pitched our tents near the ruined, but picturesque, village of Kopaci in very cold and snowy weather. The village was surrounded by swamps, and several sluggish streams and wells were within easy reach.

The commonest mosquitoes we had to deal with may be classified as follows:—

Anophelines:—

A. maculipennis.
A. bifurcatus.
A. superpictus.
A. pseudopictus

Culicines:—

T. spathipalpis.
T. annulata.
C. mimeticus.
C. pipiens.
C. hortensis.

The larvæ of many of these are difficult to distinguish, but we hatched out many hundreds in the course of our work in order to get an idea as to what genera we were dealing with.

Before going on to describe actual experimental work, a few general remarks might be interesting.

On the second week in February, after a prolonged search over the marsh, a few culex larvæ were found in a very sheltered pool, protected by a dense growth of weeds and brushwood. These were larvæ of a very large size. A few days later I heard that larvæ had been discovered in the hills the previous week. The temperature at that time was under 30° F. The question as to whether these larvæ were passing the winter in the larval stage and waiting for the warmth of spring to develop into pupæ at once arises.

Another interesting observation was the freezing of water containing larvæ during the night. This occurred on several occasions, and, curiously enough, the larvæ were as active as ever on melting the water again. We had no means of keeping the water in the frozen condition, and, consequently, are unable to say how long the larvæ will stand these low temperatures and their inability to obtain a supply of oxygen, owing to their being locked up in the ice and prevented by it from reaching the surface.

In the last week of March we began to find culex pupæ, and at the end of March both larvæ and pupæ were to be found in large numbers and in a very active state, in spite of the low temperature at that time.

On April 4 we hatched a male culex mosquito in the laboratory, and on April 12 a male culex adult was found in the open under natural conditions.

We made a collection of these early pupæ, and hatched them in bottles. Of the first collection of twenty-seven hatched, all turned out to be male culicines.

What is the significance of this? Is it not probable that it is a wise (or unwise) provision of Nature to ensure the propagation of the species? Several authorities tell us that gnats are perpetuated by the hibernation of females in dark sheltered places as barns, sheds, &c. Does it not seem something more than chance to find that the males are the first to hatch out?

Anopheline larvæ were first found on April 11. On April 17 and 18 adults of the maculipennis variety were hatched in the laboratory, and were found in the open. As regards the sex of these early anophelines, the males and females appeared in about equal numbers.

At this time we had ample opportunity of observing the depredations of several natural enemies. It was disappointing to find that some denizen of the pool had been accidentally introduced into a collection of larvæ along with the last "catch," and had killed most of them. The two most ferocious of these were the larvæ of dytiscus, one of the water-beetles, and the larva of tanypus, a chironomid.

Notonecta is also a natural enemy. This is better known to most of us

as the water-boatman. On several occasions we have seen these carry off larvæ. There are undoubtedly dozens of other pond inhabitants which prey upon mosquito larvæ. We have mentioned only these because we actually saw them in action, so to speak. Few of our mosquito larvæ escaped the pink jaws of the tanypus larva if he got into their midst.

On several occasions we experimented with tadpoles, but we never saw them touch any of the larvæ.

Another peculiarity was forced on our notice. That was the effect of agitating the water in a flask or bottle on the hatching of the mosquito. Frequently we made a collection of pupæ, and found only drowned adults by the time we got home. This may have been due to the heating of the bottle during transit in the car, but we think the shaking had something to do with it, for we noticed the same thing in the laboratory after the flask had been moved or shaken.

Another question interested us, as will be seen by some of our experimental work. Does paraffin merely drown the larvæ, or has it the additional property of being toxic? We came to the conclusion it was very powerfully toxic. Of course, by "paraffin," we mean "mineral oil, burning," as issued on service. This may not be so refined as what we call paraffin at home. It is, without doubt, toxic, and will kill larvæ in much less time than it would take to drown them, especially if it is mixed with the water, and not merely allowed to form a film. This is easily demonstrated.

It being early in the year, the larva of the culex was, at first, the only type available. Different collections of larvæ of the same genus showed great differences in their power of resistance to the larvicides used. Some were killed off quickly, while others took a much longer time to die. Consequently we repeated our experiments, and noted the longest times in which it took the larvæ to die off. Controls of larvæ in fresh water were used in all investigations.

Paraffin.

Last year, when in charge of anti-malarial parties in the Corps Area, we noticed that not only were larvæ killed in pools that had been treated with paraffin, but that fish, frogs, water-tortoises, and newts were also killed—and in a very short period of time. From this we concluded that the action of paraffin was not merely a mechanical one, but that it was toxic as well, and that probably one would get better and quicker results by not only spraying the oil on the surface, but by mixing it thoroughly with the water.

We decided to test whether this idea could be backed up by actual experiment. We first prepared what we called, for convenience, "paraffin water," as follows:—

One hundred cubic centimetres of water was taken and thoroughly shaken up with two drops of paraffin. This mixture was allowed to stand over

night in order to give the finest oil globules an opportunity of rising to the surface and forming a film. The following day the "paraffin water" was carefully drawn off from underneath the film, and put into a test-tube. Into this about six culex larvæ were introduced.

Another tube with an equal quantity of pure water was taken, and into this about six culex larvæ were introduced. A drop of paraffin was carefully floated on to the surface of this water, so that no mixing took place.

A third tube containing larvæ in fresh water was prepared as a control.

The result of several observations was as follows :—

(1) *Paraffin Water Tube.*—Although the larvæ came more frequently to the surface to breathe than in the control, they were all killed in *one hour and twenty-five minutes.*

(2) *Paraffin Film Tube.*—The larvæ were not killed until *five hours* had elapsed. It was noticed that on attempting to reach the surface, they turned back on approaching the paraffin film.

(3) *Control.*—The larvæ in this tube were quite healthy and lively at the end of the experiment.

We went a step further and introduced into our next series of experiments a test-tube containing "paraffin-water" mixture, with a film of paraffin on the surface, and a tube containing water with a film of castor oil on the surface, the larvæ having been introduced into the test-tube before the films of paraffin and castor oil were floated on the surface.

In all, five preparations were made, larvæ introduced and carefully watched: (*a*) Paraffin water. (*b*) Paraffin water with paraffin film. (*c*) Pure water with paraffin film. (*d*) Pure water with castor oil film. (*e*) Control of pure water.

In the "paraffin water" the larvæ were killed in from one and a half to two hours. Larvæ rose to the surface to attempt to breathe within five minutes.

In the "paraffin water and film" all larvæ were killed in two hours. They rose to the surface and tried to breathe within five minutes.

In the "pure water and paraffin film" all were killed in five hours forty minutes. They attempted to rise to the surface, but turned back when half way up. This must have been caused by a diffusion of something from the paraffin film which is probably toxic, and accounts for the rapid killing of the larvæ in the "paraffin water" mixture (*a*).

In the "pure water and castor-oil film" the larvæ rose right to the surface within half an hour, and attempted to breathe. This corresponded with what was observed in the "control." There was no attempt to turn back and no agitation as they got near the oil film. From this we may take it that this castor oil film was acting mechanically, and would only produce death by suffocation.

The larvæ in this preparation were seen alive and active after sixty hours, but dead at seventy hours.

In the "control," after seventy hours had elapsed, the larvæ were still alive and very active.

It was difficult to tell exactly when they were all killed. We got over this by attempting to resuscitate them by washing them gently in frequent changes of pure water.

These experiments with paraffin rather lead one to think that one would get better and more lasting results by mixing the paraffin with the water in treating pools than by simply spraying it on the surface so as to form a film, and also that one cannot expect a water fit for drinking and cooking purposes to be drawn off from underneath the surface of an oiled pool. It is reasonable to believe that a water which will kill fish, water-tortoises, and frogs is not fit for drinking purposes.

Cresol.

Cresol has always been available on active service, and we thought it would be of interest to test the effect of dilutions of it on mosquito larvæ. Particulars of the make of the sample we used could not be got, as the label had been rubbed off the drum, but from earlier experiments done in this laboratory we know that the average carbolic acid coefficient of cresols out here is from eight to nine, and is rather low.

Seven dilutions were made, from 1 to 1,000 to 1 to 1,000 millions. These were put in test-tubes and larvæ (culex) were added to each. The results were extremely satisfactory.

Cresol.

1 oz. per	Dilutions of cresol	Remarks
1 cubic foot	1—1,000	Killed within 2 minutes
10 cubic feet	1—10,000	,, ,, 15 ,,
100 ,, ,,	1—100,000	,, ,, 1 hour
1,000 ,, ,,	1—1,000,000	,, ,, 4 hours
10,000 ,, ,,	1—10,000,000	,, ,, 12 ,,
100,000 ,, ,,	1—100,000,000	,, before 20 ,,
1,000,000 ,, ,,	1—1,000,000,000	Alive after 24 ,,

These results are based on several series of experiments, and the times given were the longest noted.

From this experiment cresol could be used as a larvicide in pools in a working strength of, say, 1 part in 1 million, or, perhaps, 10 millions, if one allows for rapid evaporation in the pool.

As regards poisoning the water, it is not likely that 1 in 10 millions of cresol, or even 1 in a million, would give rise to symptoms. It would probably act as nothing more than a mild intestinal antiseptic.

Sanitas-Okol.

A series of experiments were made against culex larvæ with this proprietary preparation. Although on the tin the Rideal-Walker coefficient was stated to be eighteen, the results obtained were not so good as with cresol :—

SANITAS—OKOL.

1 in 1,000	Killed in 6 minutes
1 in 10,000	,, ,, 33 ,,
1 in 100,000	,, ,, 6 hours
1 in 1,000,000	,, ,, 12 ,,
1 in 10,000,000	Alive after 48 hours
1 in 100,000,000	,, ,, ,,
1 in 1,000,000,000	,, ,, ,,

Sanitas-okol is supposed to be poisonous to men and animals. I believe this is stated on the label. Perhaps that is why it has not been used much against larvæ. The 97th Sanitary Section used it extensively in 1917 for treating deep quarry pits, which were difficult of access, and from which animals were not likely to drink. It is probably more expensive than cresol, and, as a larvicide, does not appear to be nearly so efficient. Cresol was always available, while sanitas-okol could only be got with difficulty.

We decided to repeat on the pupæ some of the experiments done on the larvæ. It is held that the pupa lives on air alone for the short period it exists as a pupa. Taking this for granted, one would expect that it would show itself less resistant to the mechanical action of a castor-oil film and also to the combined mechanical and toxic action of the paraffin film, but more resistant to the "paraffin water," the action of which is purely toxic. This is exactly what did occur:—

These preparations were made, pupæ were introduced and times noted: (*a*) Paraffin film. (*b*) "Paraffin water." (*c*) Castor-oil film—equivalent to drowning. In (*a*) the pupæ died off in half an hour. In (*b*) they were alive after three days. In (*c*) they died after about two hours had elapsed. Compare this with the effect of these substances on larvæ:—

	Paraffin film	Paraffin water	Castor oil film
Larvæ.	Survived 5½ hours ..	Survived 2 hours ..	Survived over 60 hours
Pupæ.	Survived ½ hour ..	Alive after 3 days ..	Survived 2 hours

The above experiments with paraffin prove that to destroy larvæ it is much better to mix the paraffin, or paraffin and green-oil mixture, with the water to be treated. Similar results were got with anophelines as with culicines: mixing the oil with water will kill the larvæ in half the time it takes to kill by simply making a film on the surface without mixing.

For the same reason one would expect pupæ to be much more resistant to cresol than the larvæ. This also turned out to be the case:—

CRESOL ON CULEX PUPÆ.

1 in 1,000	Killed in 1 hour 2 minutes
1 in 10,000	,, ,, 4 to 8 hours
1 in 100,000	Alive after 3 days

Compare this with its effect on the larvæ:—

CRESOL ON CULEX LARVÆ.

1 in 1,000	Killed in 2 minutes
1 in 10,000	,, ,, 15 ,,
1 in 100,000	,, ,, 1 hour

Effects of Cresol and Sanitas-Okol on Anopheline Larvæ.

Anopheline larvæ react like culex larvæ to cresol and sanitas-okol. Both anopheline and culex larvæ appear to be more resistant to these larvicides as the season advances. With the anopheline larvæ, as was the case with the culex, cresol proved itself to be much superior to sanitas-okol as a larvicide.

Four dilutions from 1 in 1,000 to 1 in 1,000,000 of each were taken, and anopheline larvæ were added to these:—

Cresol.

1 oz. per		Dilution		Remarks
1 cubic foot	..	1 in 1,000	..	Killed in 4 to 5 minutes
10 cubic feet	..	1 in 10,000	..	,, ,, 30 minutes
100 ,, ,,	..	1 in 100,000	..	,, ,, 3 to 4 hours
1,000 ,, ,,	..	1 in 1,000,000	..	Alive after 48 hours

Sanitas—Okol.

1 in 1,000	..	..	..	Killed in 8 minutes
1 in 10,000	..	..	..	Died after 12—24 hours
1 in 100,000	..	..	..	,, ,, about 48 hours
1 in 1,000,000	..	..	..	Alive after 48 hours

Experiments on Egg-Rafts.

These were the most interesting experiments of the whole series, for they showed that dilutions of cresol of from 1 part per 1,000,000 to 1 part per 100,000,000 will kill minute larvæ almost immediately they leave the eggs; that is, as little as one ounce cresol to 100,000. Further, 1 part in 1,000,000,000 parts of water will kill off these minute larvæ in twenty-four hours. In a control experiment these very minute larvæ were all alive after four days.

This being the case, it is obvious that in cresol, which is always with us on service, we have a good larvicide in such weak dilutions that no possible harm can result if the water is used accidentally for drinking purposes by man or animals.

In these high dilutions the female mosquito is not prevented from laying her eggs on the surface of the water, but the larvæ will die shortly after the eggs hatch.

Thus pools so treated will act as traps, and encourage the mosquito to lay eggs which will never get near the pupa stage of development.

On the other hand, pools treated with oil are of no use as traps, for the female mosquito will not lay her eggs in an "oiled" pool.

This trapping effect is well shown in the case of a disused R.E. Well, 6 feet by 6 feet by 7 feet.

April 22.—The well was full of very small larvæ. It was treated with four ounces cresol, or about 1 part per million. Six hours later only a few large larvæ were found alive. Heavy rainfall during the night, which must have very much diluted the mixture.

April 23.—All the small larvæ had disappeared.

April 27.—Large number of egg-rafts floating on water surface.

May 1.—Large numbers of minute larvæ were observed, the eggs having hatched out since April 27. The well was then treated with another 1 part per million.

May 2.—All the larvæ killed off.

May 3.—No larvæ can yet be seen, although there is a great increase of egg-rafts.

May 6.—No larvæ can be found, but there is an immense number of egg-rafts floating on the surface.

Experiments on Pools.

(1) A small pool containing thirty-six cubic feet of water was treated with 3½ fluid ounces of cresol or 1 part per 10,000. All insect life in the pool was killed in fifteen to twenty minutes. Tadpoles were killed, and both frogs and water tortoises left the pool. After fourteen days, in spite of rainfall, no larvæ have reappeared.

(2) A pool containing seventy-four cubic feet of water had ¾ ounce cresol added, or 1 part in 100,000, the mixture being well splashed into the grass and weeds at the sides of the pool. Twenty-four hours after treatment only a few larvæ could be found.

(3) Two other pools were treated with 1 in 100,000 cresol, with excellent results.

Bleaching Powder as a Larvicide.

If paraffin or cresol is not obtainable, good results could be got by using bleaching powder. The sample of powder used contained 23·6 per cent available chlorine.

Dilutions of 1 in 1,000 parts to 1 in 1,000,000 parts were made, and gave the following results:—

Bleaching Powder 23·6 per cent.

Dilutions	1 oz. per	Result
1 in 1,000	1 cubic foot	Killed in 4½ hours
1 in 10,000	10 cubic feet	,, under 48 hours
1 in 100,000	100 ,, ,,	,, ,, 48 ,,
1 in 1,000,000	1,000 ,, ,,	Alive after 48 ,,

Bleaching powder could be used in an emergency, but is far too unstable for general use.

Carbolic Acid.

Carbolic acid gave very disappointing results. Most works state that one ounce to ten cubic feet is sufficient to kill off larvæ, but we found that cresol was very much better, and certainly it would not be nearly as poisonous when used in proper working strengths.

Our experiments with carbolic acid satisfied us that one ounce to ten cubic feet was much too weak. Larvæ lived in this for over forty-eight hours.

The acid used was ninety per cent carbolic acid. Probably crude carbolic would be a better larvicide, as it contains besides carbolic acid, cresols and the higher phenols. These cresols add considerably to its disinfectant power.

Note.—In these reports the "cresol" used was liquor cresol saponatus, and the "paraffin" used was the ordinary "mineral oil, burning," as issued by the A.O.D.

We are satisfied from these experiments that cresol, even in high dilutions, is a very valuable larvicide, and could be relied on under active service conditions when paraffin is unobtainable.

When paraffin is used, better results will be got by mixing the paraffin with the water. Undoubtedly it has a very powerful toxic effect on mosquito larvæ, and it is this toxicity, combined with its mechanical action of forming a film on the surface, and so drowning the larvæ, as well as its cheapness, in normal times that makes it such a valuable larvicide.

On the other hand, water treated with paraffin, even if carefully done, is not fit for human consumption, and animals, especially the mule, will refuse to drink it.

We greatly regret we had no opportunity of trying the Panama Canal larvicide. It is to all intents and purposes a cresol, but we do not think it would give such good results.

We also regret we had not sufficient time to experiment further on the larvæ in their natural surroundings. Much more work requires to be done in order to arrive at a suitable dilution of cresol as a larvicide. We notice in the last edition of "A Memorandum of Diseases of the Tropical and Sub-Tropical War Zones," it is stated that cresol diluted 1 in 50 is a good larvicide. With this dilution the cost would be enormous and prohibitive. The writer probably meant 1 in 50,000, but had he stated 1 in 100,000, or, even, 1 in 1,000,000, we should have taken it for granted that he had experimented with it.

Our thanks are due to Major-General Sir M. P. Holt, K.C.M.G., for permission to publish this paper, and to the many other officers, too numerous to mention, who have helped us in our work.

NOTE ON THE RELATIVE PROPORTIONS OF AMŒBIC AND BACILLARY DYSENTERY AMONG THE TROOPS OF THE EGYPTIAN EXPEDITIONARY FORCE DURING THE SEASON OF 1917; TOGETHER WITH SOME REMARKS ON THE QUESTION OF CYTO-DIAGNOSIS.

By H. M. WOODCOCK.

(A) THE PROPORTION OF AMŒBIC TO BACILLARY DYSENTERY IN THE EGYPTIAN EXPEDITIONARY FORCE DURING 1917.

IN the interesting article by Brevet Major P. Manson-Bahr on the pathology and bacteriology of bacillary dysentery, in a recent number of this Journal (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. xxxiii, August, 1919, p. 117), certain statistics are given relative to the proportions of amœbic and bacillary dysentery, as to which a few words of amplification and explanation are, I think, desirable.

In the first place, however, I should like to correct an impression which seems to be given, that I am one of those who have greatly inflated the number of cases in which *Entamœba histolytica* has been the causative agent and minimized the number due to *Bacillus dysenteriæ*. Among his references in connexion with this point (p. 117), Bahr includes my paper on "Protozoological Experiences during 1916" (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. xxix, 1917, p. 290). It is not perfectly clear to me whether the author cites these references as themselves illustrations of the mistake referred to, or whether he means that in these papers the mistake is already pointed out as having occurred.

In case the former was Bahr's intention (as I read it to have been), I will take this opportunity of repeating what I have always maintained, that the proportion of dysenteric cases regarded as amœbic has been, in general, estimated much too high, especially of the earlier ones (1915). Thus in the paper cited I found that "dysentery among the British cases examined" [in the Southern Canal Zone] "was, with few exceptions, *not* amœbic, but due to some bacillary infection" (p. 291); and, again (p. 294) I wrote: "In a dysenteric stool there is more likelihood of an inexperienced person mistaking large macrophages for resting *histolytica*; this has probably occurred by no means infrequently in the recent past and I think it is still advisable to lay stress upon this point. Otherwise, there is a danger of the number of amœbic dysentery cases being erroneously inflated." The above quotations clearly indicate my opinion as to the value of many of the previous estimates of the proportion of amœbic dysentery.

It so happens, however, that it is precisely with regard to Bahr's own

figures as an indication of the relative proportions of amœbic and bacillary dysentery amongst the troops on the Southern Palestine Front during the late summer and autumn of 1917 that I think they minimize unduly the percentage of amœbic. According to the table of infections given on p. 122 (loc. cit.), Bahr found that only seven out of 664 acute cases (with blood and mucus) were associated with *E. histolytica*, the calculation being, therefore, that only 1·05 per cent. of the dysentery was amœbic. The author states that the inference to be drawn from his statistics is that, at the end of 1917, the amœbic factor as a cause of acute dysentery was a minimal one. That is so; but by that time all cases of dysentery had become reduced nearly to a minimum (*vide* also his chart), p. 123 (loc. cit.).

But lest the inference should be drawn that the author's minimal figure of 1·05 per cent represents the average percentage of amœbic dysentery contracted by the troops in Southern Palestine *during the season* (including the months when this type was at its height), it should be pointed out that this figure conveys a somewhat incorrect idea. From the beginning of August onwards, I was stationed at the Kantara Military Laboratory, on the lines of communication, and made all the microscopical examinations of the dysentery cases. All the sick coming down the line passed through the stationary hospitals at this place; hence an accurate estimate could be formed of the types of dysentery prevailing on the front as a whole. In the accompanying table I have compared, as far as possible, observations made at Kantara and at No. 3 field laboratory, Rafa.* Those at Kantara are taken from the laboratory records, while the others are taken partly from dysentery returns circulated to the laboratories and partly from Bahr's paper.

Kantara Military Laboratory			No. 3 Field Laboratory, Rafa		
Period 1917	Acute cases (blood and mucus)	Number and percentage of amœbic dysentery	Period 1917	Acute cases (blood and mucus)	Number and percentage of amœbic dysentery
August ...	226	19 (8·4)	August ...	No return	No return
September ...	174	15 (8·6)	September ...	194	3 (1·5)
October ...	274	10 (3·7)*	October ...	340	4 (1·2)
Totals ... (April-October)	865	61 (7·0)	Totals ... (Sept.-Dec.)	664	7 (1·05)

* The percentage this month was the lowest of the season, the proportion of bacillary dysentery being, on the other hand, highest.[1]

[1] A chart of the variations in amœbic dysentery for the season of 1917 is given in the *British Medical Journal*, 1918, ii, December 28. Owing to my being away and not being able to receive a proof, this chart is on a much more reduced scale than was intended.

The difference between the two sets of findings is, it will be seen, considerable, the proportion of amœbic obtained at Kantara being as 1 in 14 (about), instead of as 1 in 95 (about) at Rafa. One or two points in connexion with the table have to be noted. For August, one of the two months in which amœbic dysentery was most prevalent, no return was given for Rafa (I believe the laboratory did not come into operation until towards the end of the month). But as the percentage for September, the other high month, was also very low, I do not know whether figures for August would have appreciably altered the general proportion. Further, the numbers given for No. 3 Laboratory for September and October are, as a matter of fact, the whole amœbic findings for those two months; the returns did not distinguish between the findings of active *histolytica,* and of precystic forms and cysts. I have assumed that those given were all cases of amœbic dysentery; otherwise the proportion would have been still lower for those months. (During the three months—August—October, it may be mentioned that, in addition to the dysenteric cases given, thirty-four such findings were obtained at Kantara; these related of course only to British cases.) According to the records at Kantara, the main season of dysentery, whether amœbic or bacillary, during 1917, was from April—October. After the beginning of November its place was largely taken by malaria.

The following is, I think, the most likely explanation of the important difference noted. Owing to the fact that the onset of bacillary dysentery is (usually) more rapid than that of the amœbic type, i.e., as regards the appearance of blood and mucus, a field laboratory, in which the stool will be examined soon after a man first reports sick, is more liable to miss commencing cases of amœbic dysentery than it is to miss bacillary cases; because, in such early cases, the amœbæ, if present, may still be too scarce or irregular in occurrence to be detected without the expenditure of more time and labour than can be spared over an individual case. It is at least probable that a certain number of the cases which were negative in the diarrhœal stage, when examined at Rafa, were among those which showed acute amœbic dysentery by the time they reached Kantara.

It is obvious, however, that such conditions can hardly facilitate the correct determination of the relative proportions of the two types of dysentery, in any outbreak in the field. If an accurate idea is required, for statistical purposes, of the relative percentages of amœbic and bacillary, during the season of 1917, the figures obtained at Kantara are undoubtedly more complete and reliable than those obtained at Rafa.

From what I have said at the commencement of this note, it is clear that I should be the last to deny the great preponderance of the bacillary type. Amœbic dysentery was never, numerically, a very important factor among the British troops, either in Egypt, Sinai or Southern Palestine; but that was all the more reason why such cases as did occur should be duly recognized. And it cannot be maintained that the percentage found, namely,

7 per cent of the blood and mucus stools,[1] was either minimal or negligible. Bahr points out (loc. cit., p. 119) that the proportion of *Entamœbæ* to the number of diagnosed bacillary cases recorded will be invariably higher in base laboratories than in those nearer the front line. But I do not think that a reader of his paper would be likely to gather from it that the percentage of amœbic dysentery for the season was about seven times as much as is there stated.

It is evident that Bahr concentrated his attention on the bacillary type of the disease; and, obviously, that was the most urgent question. Still, I cannot agree with those who consider that all cases of acute dysentery occurring in the field are bacillary; in my opinion that is going too far, especially with the history of Gallipoli before us, even when a large number of the alleged amœbic cases in that outbreak are eliminated. And the Kantara records show that a certain number of acute amœbic cases *originated* on the Southern Palestine front, if the patients had arrived some distance down the line before they *developed*. At any rate, the necessity and value are apparent, of subsequently controlling as soon as may be a preliminary, in the nature of things, more or less hurried examination at the outset, when the patient is waiting for a rapid diagnosis before being sent on.

In his introductory remarks, Bahr is inclined to depreciate the practical value of the stool-examinations made by the laboratory worker—shall I say, more especially the protozoologist?—and to regard his findings as not conveying, of themselves, a true impression of the relative prevalence of the two main forms of dysentery, unless intelligently interpreted in connexion with clinical data.

Now, may I be allowed to say that, during my experience of nearly three years with the Egyptian Expeditionary Force, I came to realize how very largely the clinician *was*, as a matter of fact, dependent on the laboratory worker for his diagnosis, in the case of commonly occurring tropical diseases. And I think most of the clinicians I met would assent to this statement. To take the two chief varieties of disease which were responsible for most of the sickness amongst the troops, namely, dysentery and diarrhœa, and the pyrexias. Without the services of those who had an expert knowledge of pathogenic protozoa, the clinicians would have been, in very many cases, at first at a loss. The microscopic diagnosis of the type of dysentery rests ultimately, and indeed chiefly, as I point out below, on the presence or absence of *E. histolytica*; while, as regards the pyrexias, in a malarious country like Palestine, it was of the first importance to detect quickly whether malarial parasites were present or not, and if so, their type. I need not refer further, at present, to the latter disease,

[1] This proportion, it is interesting to note, is nearly the same as (slightly higher than) that found by Wenyon and O'Connor amongst British dysenteric patients in 1916, namely, 6·1 per cent. These observers were also working in the Northern coastal sector (Alex.).

as I hope to give later on an account of the malaria which came under my notice while with the Egyptian Expeditionary Force.

But as regards dysentery, I cannot do better than quote the words of two of the foremost living authorities on tropical diseases; the one for the Near East, the other for the Middle East. The author of a recent (1916) memorandum on diseases in the Mediterranean war area says, under "differential diagnosis of amœbic dysentery" (p. 29): "From bacillary dysentery by microscopical examination of the stools and bacteriological tests. Clinically, the diseases can rarely be differentiated, though a severe onset and a rise of temperature suggests the bacillary form." As to the last clause, it may be remarked that while these signs may be very helpful when a fresh case is admitted, they are often not of much use when a case has to be diagnosed five to seven days after the onset, and when, moreover, the patient has at times become (unavoidably) separated from his clinical notes and chart. And in chronic cases, such as were frequently met with among natives, a clinical diagnosis as regards the type seems to be, from what I saw, generally almost impossible. Again, Sir Leonard Rogers, in his book on the dysenteries writes, under the heading "Moderately acute amœbic colitis with typical dysenteric symptoms" (p. 89): "It will be as well at the outset to emphasize the fact that in the average case of amœbic colitis the clinical symptoms present no definite and constant points which will enable the disease to be distinguished from .... bacillary dysentery." Upon naked-eye characters of the stools, the same author says (p. 91): "It will be advisable to state once for all that there is no single and constant feature whereby the evacuations of amœbic dysentery can be distinguished from those due to other inflammatory conditions of the large gut." Lastly, under the diagnosis of bacillary dysentery (p. 282), it is stated that "it is a much more difficult matter to differentiate the bacillary from the amœbic disease, especially in warm climates where the latter is so prevalent."

From the words of both these eminent authorities, it is clear that microscopic diagnosis from the stool is the all-important means of distinguishing between the two types of dysentery. If active *E. histolytica* are found in a stool, it certainly indicates that an active amœbic lesion is present in that case, which ought to be attended to. And I do not know that any microscopist has claimed more than that from this finding; so far as I am aware, "carrier" and quiescent cases (showing precystic forms or cysts) have always been separated as such. It is quite true that occasionally mixed infections of amœbic and bacillary dysentery occur; I refer to certain which have come under my own observation below. The remarkable thing is that Bahr himself seems not to have seen such cases—the one condition of a stool where the microscopist might possibly be the means of focusing attention on the less urgent disease of the two in a particular case.

The opinion expressed by a bacteriologist of such high standing as

Bahr, with regard to the value of the findings made by the pure microscopists, is not, therefore, altogether happy; more especially as one of the chief objects of his own paper is to show that a practically safe diagnosis of bacillary dysentery can be made in many cases from the microscopical examination of the stool alone, without even waiting for the isolation of the organism concerned. Had experienced protozoologists been able to examine the stools of the Gallipoli cases, there can be no doubt that many mistakes would have been avoided; while their presence in the laboratories of the Eastern war zones, subsequently, was still instrumental in preventing further errors. I myself met more than one highly competent and able laboratory worker, who did not know a *histolytica* until I pointed one out. Naturally, no discredit attaches to these and to many others at first in a similar position; because they had had no experience of parasites with which protozoologists are familiar. The protozoologists who served in the East had no official standing, no recognition, and have been refused, by the Treasury, any gratuity; nevertheless, I do think their services were appreciated by the clinicians whom they were able to assist.

I have digressed somewhat from my subject; but, before I leave the question of the incidence of dysentery, I should like to add that I read with much interest a remark of Bahr's that it has been noted, as a general rule, that the number of amœbic cases increases some four to six weeks after troops have moved forwards into new country, and *have drunk unsterilized water* (the italics are mine). This statement furnishes additional evidence in support of the view I have lately revived (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. xxx, 1918, p. 110, and *British Medical Journal*, 1918, ii, December 25) that water is a much more important vehicle of transmission for *amœbic* dysentery than is the fly. Of the two forms of dysentery, amœbic is more readily preventable than bacillary, and there can be little doubt that it was owing to the excellent work performed in connexion with the water supply that the amount of amœbic dysentery among the British troops during the season of 1917 was not greater than was actually the case.

(B) THE QUESTION OF CYTO-DIAGNOSIS.

It is not intended to describe here in detail the characters of the cellular exudate in the two types of dysentery, as this has been done thoroughly by several workers of late (Bahr, loc. cit., Wenyon and O'Connor, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. xxviii, February, 1917, Willmore and Shearman, *Lancet*, 1918, ii, August, and others). While together at Suez in 1916, Captain Willmore and myself spent much time in discussing this question and in comparing specimens, and he fully persuaded me of the great value of this character, in many cases, as a diagnostic point. But in spite of much additional experience since then, I am not convinced that it ought to be regarded, for routine purposes, as the *chief* criterion in

the microscopic diagnosis of dysentery. A considerable amount of attention has been paid recently to the advocacy of the rapid diagnosis of a dysenteric stool from the appearance of the cellular exudate; so much so that I cannot help thinking there is, perhaps, a likelihood of the impression being gathered that more reliance is to be placed, in general, on this character than on the question of the presence or absence of amœbæ. I think, therefore, that a word or two of caution may be advisable, more especially for the benefit of those, not yet so accustomed to the microscopic examination of stools, who may be taking up such work under rather different conditions, now in peace-time, from those obtaining when outbreaks occur among troops in the field.

Undoubtedly, in many cases, a correct diagnosis of bacillary dysentery can be given more rapidly and easily from the character of the exudate in a blood and mucus stool, than by assuring oneself of the absence of amœbæ. But, if the two criteria be regarded independently for a moment, diagnosis on the former ground is not so safe, on the whole, as that based on the determination of the presence or absence of *E. histolytica.* In other words, if the time were spent in considering the cellular exudate, *rather than* in searching for amœbæ, one might —not seldom—come to a wrong conclusion. There is a tendency among the exponents of the cyto-diagnostic view to paint vividly what I would call the extreme pictures presented by the two types; on the one hand, clumps and masses of pus-cells (polymorphs), numerous typical large macrophages, a varying number of red corpuscles, an almost entire absence of micro-organisms, and, of course, no *histolytica;* on the other hand, a quantity of blood-cells, numerous active *histolytica*, bacteria, and a few unhappy-looking lymphocytes. As regards the bulk of the active dysenteric cases, however, which the laboratory worker is called upon to diagnose microscopically in the course of his ordinary routine, the matter is far from being so simple. It has to be remembered that between the two extremes are to be seen pictures showing every gradation as regards the type and proportions of the cells; and a large number of these, at any rate, may be on occasion due either to amœbic or bacillary dysentery. Of course, the nearer the picture is to one of the extreme (i.e., acute or epidemic) bacillary type, the greater is the aid afforded by the consideration of the exudate.

The bacillary type above outlined was of common occurrence in fresh acute cases contracted by the troops on the field. The amœbic picture, on the other hand, was rarely seen by me in fresh British cases. I found it not uncommonly in native cases, particularly amongst the E.L.C., and I came to regard it as representing a long-standing infection, probably with advanced amœbic lesions of the bowel; I also met with it once or twice in non-British Europeans (civilians in Egypt), who gave a definite history of several acute attacks of amœbic dysentery. (I note that most of the cases from which Willmore and Shearman depict this extreme amœbic type were very severe, or indeed fatal.)

Another type of stool, which it is easy to diagnose, in this case from the macroscopic appearance alone, is that consisting of thick, ropy mucus, white or greenish (bile-stained), with or without fæcal matter. Microscopically, there are usually some red blood-corpuscles—they may be sparse—and much cellular exudate (pus-cells and many epithelial cells), often more or less bile-stained. This characteristic stool is, in my experience, always due to some form of bacillary dysentery, either the later stages of a fresh infection, or, commonly, a more chronic case.

The above are straightforward instances (unless complicated by the existence of a mixed infection); I will now illustrate some of the actual difficulties which arise in practice. In cases where the stool is pure blood and mucus[1] there may sometimes be no appreciable difference between the two types. I have had samples standing on my bench which could certainly not be distinguished macroscopically, yet one would prove to be amœbic, the other bacillary. In the one, the blood was rosy red, not dark brown; in the other the muco-pus was streaky and not disposed in definite flocculi. And I say unhesitatingly that anyone would have had an extremely difficult task to differentiate them microscopically, had it not been for the presence of *histolytica* in the one. Perhaps, if specimens of both had been stained and the various cells carefully tabulated and counted, a guess might have been made according to their different proportions, as ascertained in the two cases. But, at any rate, I should not like to have had to diagnose them from a general examination of the exudate. And it may not be out of place to add that I distinctly recollect once or twice handing over to my colleague at Kantara a specimen which I had found was amœbic, with the remark that he would probably find it bacillary also; and, in the result, Flexner-Y or Shiga was isolated.

It must not be thought that all cases of active amœbic dysentery (in which blood and mucus are present in the stool) show no, or only few pus-cells; these are at times (e.g., in fairly new cases) quite numerous; the picture then seen may closely resemble that of many bacillary stools, where the cellular exudate is not so abundant that clumps or agglomerations of pus-cells occur. In amœbic cases of this kind, the amœbæ may be very patchy in distribution, necessitating sometimes considerable search before one is seen. Far more important, in such cases, than the actual number of pus-cells, is the presence of pus-cells which show a characteristic appearance of disorganization (the so-called "ghost-cells.") When they occur, these indicate certainly bacillary dysentery; but they may be very scarce and, indeed, sometimes cannot be found at all.

It is with the greatest diffidence that I venture to differ slightly from Willmore, who is one of the most brilliantly clever, all-round men I had the

[1] In cases of acute amœbic dysentery, there may be *no* fæcal material, the motion being a small one, consisting solely of bright red blood and mucus.

privilege of meeting. But when he says (loc. cit.) that "pure amœbic dysentery gives rise to a characteristic exudate in the stools" (meaning the picture I first indicated), I can only point that I have not found that picture to be anything like as common (or typical) as are the characteristic bacillary pictures I have referred to. I am more in agreement with the account given by Wenyon and O'Connor (loc. cit.). I cannot quote here all that they say upon the subject, but should like to give one or two important sentences; I have added, in square brackets, one or two small qualifications which seem to be required. "Microscopic examination of the stools of the amœbic dysenteric shows" [in most cases] "nothing characteristic apart from the amœbæ. Cells of many kinds are present, in fact, any of the cells described as occurring in bacillary dysentery. But the cells are never present in such numbers" [as they may be in acute cases of the latter disease] "and one does not find that condition where the whole field is covered with them."

Willmore would probably regard the type of case I have alluded to above as one of a mixed infection; bacillary dysentery being present as well as amœbic. I can only say that in most instances this has not been the case. Thus during the two months August and September (to refer, again, to the figures given in the first part of this note), three "mixed" cases were definitely determined; and in two of these, as said, I felt almost sure that they were "mixed" before the isolation of the bacillary cause was effected. All stools were plated, and during the two months specified, my colleague, Captain Stuart, R.A.M.C., isolated a dysenteric organism in forty-five per cent of the blood and mucus stools; an excellent proportion, considering the age of most of the cases when they arrived at Kantara. It may be assumed, therefore, that, at the outside, the number of "mixed" cases was not more than about twice that actually determined, perhaps not so many; but say, seven. Now there were during the same period no less than thirty-four active British amœbics—most of them could be called acute; mainly, of course, fresh cases. And in a very much larger number than seven of these—writing from memory, I should say at least half—this particular indeterminable condition, as regards the cellular exudate alone, was present.

Again, there is a common type of stool, actively dysenteric, but indicating a more chronic condition, in which there is liquid fæcal material with thin diffused mucus, containing microscopically red blood-corpuscles and all kinds of cellular elements—pus-cells, lymphocytes, epithelial and endothelial cells, many of them more or less disorganized; the cells are not necessarily in great numbers, being interspersed amongst the fæcal matter. Such stools were met with frequently, though not exclusively, among native patients. I do not believe anyone could safely diagnose such a stool from the consideration of the exudate.

Particularly as regards Indians, from my experience, many cases of amœbic dysentery might be missed if attention were concentrated too much

on the cellular exudate. Because, while at Suez, I found that *over twenty-six per cent* of the stools containing blood and mucus were amœbic dysentery; and that no fewer than twenty per cent of men in a nominally normal condition as regards their bowels, were "carriers" of *tetragena*-cysts. The normal stools of Indians are, generally, very different from those of Western Europeans ; they are bulky, often loose, containing all manner of parasites, and by no means always devoid of cells. In cases of diarrhœa and dysenteric diarrhœa, such as indicated above, these conditions are accentuated. In many of these cases it is quite likely that there is, or has been at some time, a bacillary infection, though it is often extremely difficult to isolate any pathogenic organism. But there can be no doubt that, in a large proportion of them, the actual dysenteric cause at the time is *E. histolytica ;* although, from the microscopic appearance of the exudate, it might equally be thought to be bacillary. Hence the value of a thorough search for the amœbæ ; because amœbic dysentery is probably a more important and serious factor in India than it is anywhere else.

To sum up the matter. Further study of a large number of cases, both British and native, since I wrote my paper, has only confirmed the opinion there expressed (loc. cit.) that, as a general working rule, "the presence or absence of amœbæ" [i.e., *histolytica*] "is the only *safe guide* on which to base a diagnosis of the type of dysentery from the characters of the stool-sample alone." I would like to emphasize that when a case is one of *active* amœbic dysentery the amœbæ can be found; usually, without much difficulty, and in my experience always, if sufficient time be taken over the examination. The drawback of being stationed elsewhere than at a base is that one does not know the after-history of the cases, and what one's percentage of error is. But I may perhaps be allowed to repeat again here that, while at Suez, a large number of Indian cases were examined six to eight times, at weekly intervals, and in no case of a *dysenteric condition* was *histolytica* (in any form) subsequently found when not detected at the first examination. Conversely, if *histolytica* is not present in a dysenteric stool, the case is, in all probability, bacillary (of course, I am not taking into account malarial dysentery). I feel sure that the percentage of error in diagnosis based on this ground would be, in ordinary routine work including all types of dysenteric stool, far less than that which would occur in diagnosis based on the consideration of the cellular exudate alone. By all means let us make use of the character of the exudate as a valuable aid, for instance, in the two characteristic bacillary pictures first sketched, where it is of itself sufficient; but the main, the ultimate test must always be the presence or absence of *E. histolytica.*

THE PULMONARY MANIFESTATIONS IN MALARIA.

By Major A. W. FALCONER, D.S.O.
Royal Army Medical Corps.

In the *Lancet*, 1917, Captain A. G. Anderson and I described the pulmonary manifestations of malaria as seen in the British Salonika Force in the autumn of 1916. We divided the cases into several groups. First and by far the most frequent, the bronchitic; second, pneumonic and broncho-pneumonic. We pointed out that the term pneumonic was not strictly accurate and stated that all we meant to convey was that there existed a group of cases in which the physical signs suggested areas of more or less extensive consolidation, some definitely lobar, others lobular. From a consideration of the symptoms and physical signs we considered a portion of these cases were to be explained by a superadded infection on a malarial basis, but that there was a group of cases presenting the physical signs of a more or less extensive consolidation of the lungs, in which there was no evidence whatever of a superadded infection.

Armand-Dellile, Paisseau, Abrami, and Lemaire, have since described the occurrence of four types of pulmonary complications among French troops in the Balkans.

They differentiate, first, bronchitic, which they state to be much the most frequent; second, bronchitic with pleuro-pulmonary congestion. They emphasize the fact that in many of these cases malaria is at first not suspected; third, pneumonic. They state that one gets the impression of an apical pneumonia with all the classical signs, including the dullness, the tubular breathing, and the crepitant râles. The sputum they state merely has the characters of a frank pneumonia and the condition may relapse either in situ or in some other part of the lung. The conditions they state, is notably influenced by quinine. Fourth, pulmonary apoplexy terminating rapidly in death. This form they state is very rare.

During the malarial season of 1917 I have again had the opportunity of examining a large number of malarial patients presenting pulmonary symptoms.

As before, by far the most frequent type is the bronchitic. Many of these cases are sent into hospital with a diagnosis of bronchitis and they present all the physical signs of bronchitis with numerous rhonchi and râles of both lungs. They may show either a typical malaria pyrexia and irregular intermittent pyrexia, or a subnormal temperature. The sputum is fairly characteristic. It is generally a profuse, thick, uniform, almost pure white, non-aerated sputum of cream-like consistence. As a rule the malarial parasite is readily demonstrated in the blood, the symptoms and physical signs wax and wane with the variations in the temperature

and the cases respond in a remarkable manner to adequate quinine treatment.

I have also seen a considerable number of the second group of cases, viz., those presenting the physical signs of more or less extensive consolidation of one or more lobes. Further observation has shown that in most of these the physical signs mainly depend on massive collapse of the lung and not on true consolidation.

I am indebted to Dr. B. M. Cunningham for the notes of the following cases:—

Case 1.—Pte. C., aged 28, was admitted to a general hospital with a history of pyrexia, vomiting, rigor, and pains in the limbs. Six weeks previously he had also had a slight attack of "fever." On admission to hospital there were a few rhonchi in the lungs. He was put on thirty grains daily of quinine sulphate by mouth. On the 17th the temperature rose to 99° F. but then remained subnormal till the 21st, when it rose to 99·6° F. and he developed diarrhœa with blood and mucus in the stool. He was at once given forty cubic centimetres anti-dysenteric serum and the diarrhœa completely subsided in two days. On the 24th the bowels moved once and there was no blood or mucus in the stool. On that date the patient complained of pain behind the sternum and the lungs presented a few scattered rhonchi. The apex beat of the heart was one inch inside the nipple line. At 4 p.m. Dr. Cunningham called to see the patient. He was complaining of severe pain in the chest. The pain was referred to the sixth left costal space and radiated across the left mamma. The respirations were thirty-six a minute and accompanied by a grunt. The pulse was small, regular, and its rate was ninety-six a minute. The apex beat of the heart was very visible, tumultuous, and was situated in the fourth space one and a half inches outside the nipple line. There were no murmurs. The lungs showed sibilant rhonchi over both lungs anteriorly, most marked on the right side. The back of the chest was not examined as the patient was too distressed. A blood film was taken but was negative to malaria, but the patient had been taking thirty grains of quinine for several days. At 7.30 p.m. the patient was easier and the pain had almost gone. On the 25th the temperature rose to 101° F. The apex beat of the heart was in the fourth space one inch external to the nipple line. Anteriorly the lungs still showed numerous rhonchi over both sides of the chest. There was a copious sputum consisting of thick, dull, fungoid-like masses. He was given twenty grains of quinine bihydrochloride intramuscularly and thirty grains of quinine sulphate daily continued by mouth. I saw him on the morning of the 26th inst. He was by then much easier. The temperature was 99° F., respirations 24, pulse 90. The apex beat of the heart was in the fourth space one-half inch external to the nipple line. The lungs showed distinct flattening and narrowing of the intercostal spaces in the left axilla and at the left base. The percussion note in the left axilla and at the left base and from the spine of the scapula downwards was notably

flat but not absolutely dull. On auscultation over this area the breathing was typically tubular with very marked whispering pectoriloquy. Over the right lung the breathing was harsh and compensatory with scattered rhonchi. The sputum was profuse and consisted of dull white masses. Microscopically it was mainly polymorphonuclear and showed numerous

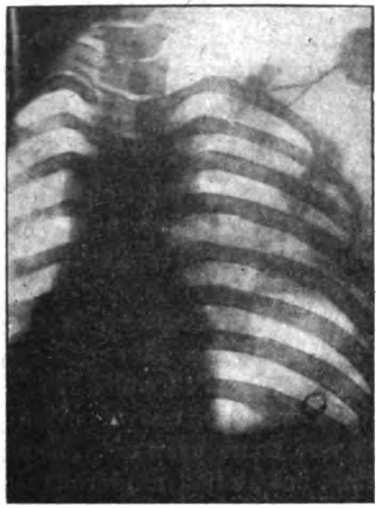


Fig. 1.

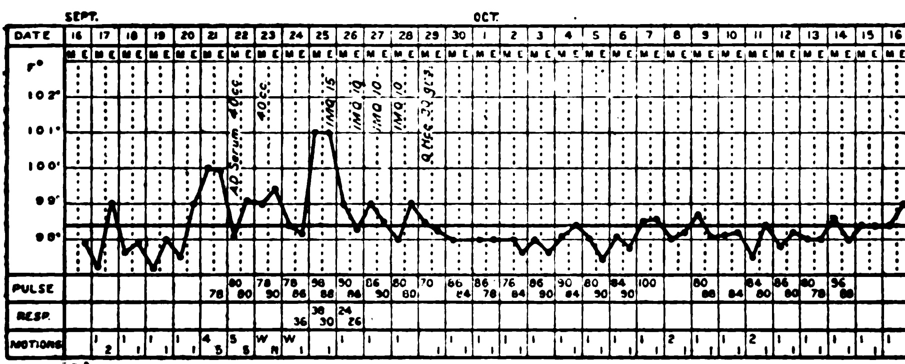


Chart 1 (Case 1).

pneumococci, many of which were contained within the cells. Unfortunately a skiagram of the chest could not be obtained. The quinine was continued by the mouth and he was ordered ten grains of quinine bihydrochloride intramuscularly for three days. On the 27th the patient was quite comfortable and the temperature was 99° F. and did not later rise above that. The sputum was notably less. The apex beat of the heart was now

a quarter of an inch internal to the nipple line. The expansion of the left base was much improved but there was still tubular breathing and whispering pectoriloquy at the extreme base. The breath sounds over the right lung were still exaggerated but the adventitious sounds had disappeared.

I again saw him on the 28th. He was now perfectly comfortable. The sputum had disappeared. The apex beat of the heart was in the fourth space half-inch inside the nipple line. The percussion note at the extreme left base was slightly less resonant than on the right side and there was slight impairment of air entry, but otherwise nothing abnormal to be made out. From this date onwards he presented no further symptoms.

Case 2.—Pte. D., aged 42, admitted to hospital on September 13, 1917, from a convalescent depot. Previous to admission to the convalescent depot he had been in another hospital suffering from malaria. On admission his temperature was 99° F., and his spleen was palpable. There was considerable dyspnœa and some impairment of the percussion note was made out at the right base. I saw him next morning. His temperature had risen to 103° F., respirations 48, pulse 112. He was in an extremely collapsed condition with incontinence of urine and fæces. There was considerable dyspnœa and some cyanosis. Examination was difficult on account of his condition, but he had numerous rhonchi and rales over both sides of the chest in front and distinct impairment of the percussion note over the right base with tubular breathing and increased vocal resonance. The leucocyte count showed: Total leucocytes, 6,000 per cubic millimetre; polymorphonuclears, 48·5 per cent; small lymphocytes, 6 per cent; large lymphocytes, 42·5 per cent; mast cells, 3 per cent. The blood film showed numerous malignant tertian parasites. He was given pituitrin and thirty grains of quinine intravenously in one pint of saline. Next morning patient's condition was distinctly better, his temperature had fallen to 98° F., his pulse to 88, and respiration to 26 per minute. The dyspnœa was much less, but his lungs were not examined on account of his condition. He received thirty grains of quinine intramusculary in the morning and as parasites were still present in the blood at 4 p.m. another thirty grains of quinine was given intramuscularly. At 6 p.m. he was quietly asleep, but was found dead in bed at 7 p.m. Lieutenant-Colonel Dudgeon, C.M.G., consulting bacteriologist, British Salonika Force, reported that the right base showed extreme congestion of the capillaries in the alveolar walls giving rise to apparent consolidation, some pulmonary collapse, parasites numerous, no inflammatory consolidation.

Case 3.—Cpl. S., aged 20, readmitted to hospital from a malarial convalescent depot on September 22, 1917, complaining of a cold in the chest. The temperature on admission to hospital was 104·8° F., pulse 104, respirations 36. A blood film showed numerous malarial rings of uncertain type. Crepitations were found over the right scapula behind. He was put

on thirty grains quinine sulphate by the mouth. From September 23 to October 1 he showed an irregular intermittent fever. On September 24 and 25 he expectorated freely, the sputum on the 24th consisting of dull white matter, on the 25th inst. it contained a few blood-stained masses. On the 26th his temperature was normal and he was much more comfortable. The sputum had almost ceased. On the 27th the quinine was increased to forty-five grains daily. On the 28th temperature rose to 100° F. and coarse râles were heard over the front of the right chest. The sputum again increased. I saw him on October 1. His temperature was 97° F., pulse 68, respirations 24 per minute. He was lying quite comfortably in bed but was expectorating freely a dull white fungoid-like sputum. On inspection of the chest the right side in front was notably flatter than the left and the intercostal spaces were notably narrower. The apex beat of the heart was in the fourth space, fully three-quarters of an inch inside the nipple line. The percussion notes on the right side in front down to the fifth rib was very definitely flatter than on the left but was not absolutely dull. On auscultation over this area the breathing was tubular with well marked whispering pectoriloquy. There were no adventitious sounds. Behind at the right base the breath sounds were diminished but not otherwise abnormal. A skiagram (fig. 1) obtained on this date shows a very distinct narrowing of the intercostal spaces over the right upper lobe, marked increased opacity of the right upper lobe, and very definite displacement of the heart to the right. A leucocyte count showed 6,000 leucocytes per cubic millimetre. From this date onwards the temperature remained normal and the physical signs in the right lung rapidly cleared up, and the apex beat of the heart returned to its normal position.

Case 4.—Pte. M., aged 24, admitted to hospital on July 9, 1917. His illness started on June 30, 1917, with shivering, followed by sweating, headache, and pains in the back and chest. On July 3, 1917, he began to cough and suffered from pain in the front and back of the chest. On admission to hospital his temperature was 98° F., pulse 120, respirations 24. Examination showed defective movement of the whole of the left side of the chest. The position of the apex beat of the heart is not noted. On percussion the whole of the left base showed dead dullness with markedly increased vocal resonance. On auscultation there was tubular breathing over the whole of the left base, ægophony, numerous rhonchi and râles and a loud pleural friction rub. Over the rest of the chest there were numerous rhonchi and râles. His physical signs remained in statu quo and his temperature normal until July 15, when he had a rigor and his temperature rose to 104° F. He was then given twenty grains quinine bihydrochloride intramuscularly and put on fifteen grains of quinine sulphate twice daily by mouth. On July 16 his temperature rose to 102° F., fell to normal on the morning of the 17th, and, except for a rise to 100° F. on July 20, remained normal for the rest of the stay in hospital. On July 17 his general condition was greatly improved and he was free from any

distress. On the 22nd he was allowed up although his physical signs at the left base had remained pretty much in statu quo. I first saw him on August 10. His general condition was excellent and he was walking about in the ward without discomfort. On examination of the chest there was marked shrinking and limitation of movement at the left base. The intercostal spaces were notably narrower than on the right side. The apex beat of the heart was situated three-quarters of an inch outside and just below the nipple. From the angle of the left scapula downwards the percussion note was almost dead dull. On auscultation over this area the breathing was exquisitely tubular with well-marked whispering pectoriloquy. There was also a leathery pleural friction rub. A leucocyte count showed

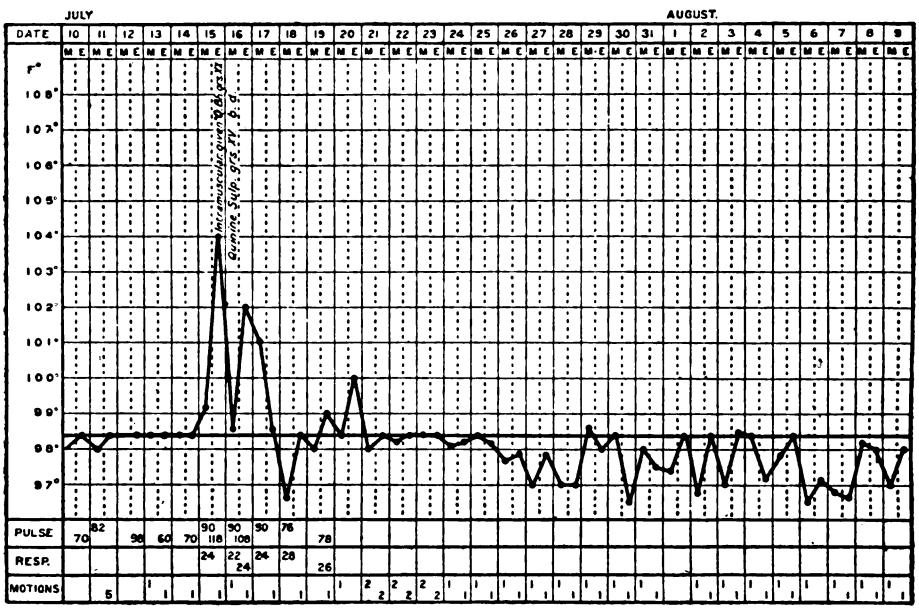


CHART 3 (Case 4).

4,600 leucocytes per cubic millimetre. A radiogram of the chest was obtained, and Captain Gordon, R.A.M.C., officer-in-charge of the X-ray department, reported: "On the right side there was considerable mottling of the whole lung and peri-bronchial thickening at the root of the lung. The left lung casts a much denser shadow than the right, and this with the falling together of the ribs suggests that there has been collapse of the lung." His general condition steadily improved, he put on weight, and except for some breathlessness on exertion he had no complaints. A second radiogram on September 2, 1917, showed the same characters as the first. A third radiogram taken on September 29, 1917, was reported on as follows: "The plate shows far less collapse of the thorax wall than that of

September 2, 1917. The increased density of lung tissue was most marked at the base and apex, the central area of the lung hardly differs from that of the opposite side. Screen examination shows diminished movement of the left diaphragm. The illumination of the whole of the left lung is still poor but considerably improved since last X-ray examination."

Physical examination still showed notable dullness of percussion over the left base. On auscultation over the left upper lobe the breathing was broncho-vesicular with numerous rhonchi. Behind at the left base there was still an area of high pitched tubular breathing with whispering pectoriloquy, and sonorous rhonchi. The apex beat of the heart was ½ inch outside the nipple line. His general condition was excellent, and he had no complaint except breathlessness on exertion. He was discharged to hospital ship in this condition.

In all these cases we have the sudden appearance of gross physical signs in the lungs occurring during a malarial attack. The physical signs when they can be properly watched, as in Cases 1 and 3, are typically those of collapse of the lung, and not of inflammatory consolidation. The temperature chart is characteristic of malaria. There is an absence of leucocytosis. The sputum is unlike that of pneumonia. In the great majority of cases it consists of dull white uniform unaerated masses, and does not show the tenacious characteristics of pneumonic sputum. At times certain portions may show blood staining, and I have occasionally seen moderate hæmoptysis. As pointed out by Armand-Delille, Paisseau, Abrami and Temaire, a striking feature of these cases is the variability of the symptoms and physical signs. As a rule these notably increase during the periods of pyrexia, to diminish during the periods of apyrexia. This is, however, not always the case, and gross physical signs in the lungs may suddenly appear without any rise in temperature or symptomatic distress, as in a case published in a previous paper by Captain A. G. Anderson and myself. The patient, aged 29, reported sick on November 1, 1916, complaining of pain in chest, headache, and shortness of breath. He was sent to hospital with a diagnosis of congestion of the lungs. On admission his temperature was 99·8° F., pulse 96, and respirations 36 per minute. He had no dyspnœa in bed, no cough, and no expectoration. His spleen was palpable. There were abnormal physical signs over the whole of the right lung. Anteriorly the breath sounds above and below the clavicle were bronchial in character, and all over the anterior aspect of the lungs were numerous moist, sticky râles, the movement was diminished, but there was no appreciable dullness on percussion. Posteriorly there was slight percussion dullness over the right supraspinous fossa and over the right base. The breath sounds in the supraspinous fossa were bronchial and in a small area just below the spine of the scapula they were distinctly tubular. Numerous râles were present all over the right lung posteriorly, and a few râles at the left base. His temperature fell to normal on November 9, 1916, and did not rise thereafter. The

physical signs over the right side of the chest gradually diminished, but on November 12, 1916, without any rise of temperature or increase in the patient's symptoms, a large area of consolidation appeared in the left lower lobe accompanied by numerous moist râles. This also slowly cleared up under quinine treatment, but there was still bronchial breathing and râles on November 27, 1916.

I have had the opportunity of obtaining microscopic sections of my one case of this type. This was obtained from a man aged 42. The week before admission to hospital he reported sick on account of a rigor, followed by sweating and accompanied by pain in the limbs. He had been taking small doses of quinine from that date. On admission to hospital his temperature was normal, his spleen enlarged, and his conjunctivæ slightly icteric. He had no pulmonary symptoms. His temperature remained normal for three days after admission, and then he suddenly developed a crossed pontine paralysis and died within twenty-four hours. At the autopsy, the lower half, or the lower lobe, of the right lung was found collapsed. Sections showed intense congestion of the capillaries of the alveolar walls, producing a noticeable thickening of the alveolar wall, and accompanied by collapse of the alveolus. In parts there were small hæmorrhagic infarcts, but no trace of inflammatory action. Malarial parasites were present in small numbers.

From the clinical characters and the scanty pathological data it would appear that those cases represent a pure malarial phenomenon, and the physical signs depend on intense vascular congestion associated with collapse of the lung. Why the lungs should collapse is not clear.

That such a lung is extremely liable to superadded infection is obvious, and there is a further type of case which suggests that this occurs.

I am indebted to Major A. G. Anderson for the notes of the two following cases.

Case 5.—Pte. J., aged 21, admitted to hospital on November 4, 1917, reported sick on November 2, complaining of headache, shivering, and pain in the limbs. He also complained of pain in the right chest on deep breathing. He had had two previous attacks of malaria. On admission to hospital his temperature was 104·6° F., pulse 88, respirations 36. He had a short frequent cough. There was dullness to percussion at the right base, with tubular breath sound and increased vocal resonance and fremitus. The rest of the lungs showed no abnormal signs. Apex beat of the heart was in the fifth space in the nipple line. He was given twenty-one grains quinine bihydrochloride intramuscularly at 8 p.m. Next day his temperature was still 103° F. His sputum was tenacious, muco-purulent, and blood stained. He was given twelve grains of quinine intravenously. His temperature remained constantly high until November 10, when it subsided by lysis, although an absolutely normal temperature was not obtained until November 14. The physical signs at the right

base slowly cleared, on November 23 the breathing was still bronchial and the percussion note impaired. By December 8 the lung was quite clear. Three blood films were negative to malaria at the height of the fever, but on December 2 patient had a rigor, and the temperature rose to 105·2° F. Benign tertian parasites were then found in the blood. Total leucocyte counts made on November 8 and November 13 showed a leucocytosis of 11,000 and 17,000 respectively.

Case 6.—Pte. H., aged 19, admitted to hospital on November 9, 1917. He reported sick on November 6, 1917, complaining of headache and pain in the right side of the chest. He had had a previous attack of malaria in August, 1916, and nine or ten relapses since. On admission to hospital his temperature was 104·6° F., pulse 120, respirations 30 per minute. Patient's general condition was bad, his spleen was palpable, his conjunctivæ icteric. The percussion note below the angle of the right scapula was dull,

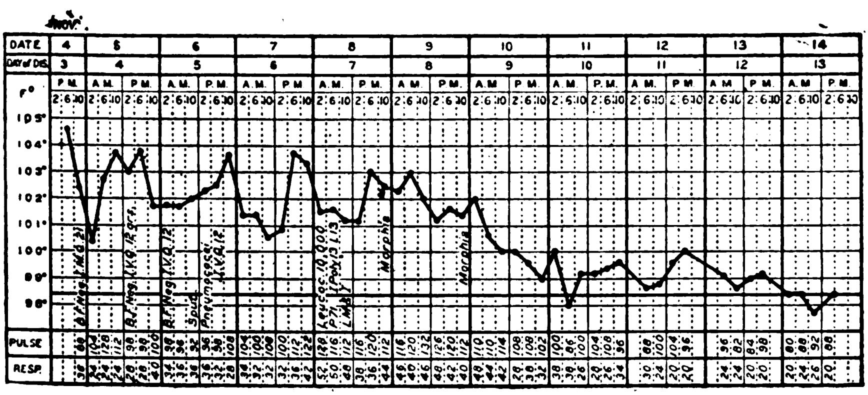


CHART 4 (Case 5).

the breath sounds were bronchial, with increased vocal fremitus and resonance, and ægophony. The rest of the lungs were clear. The apex beat of the heart was in the fifth space in the nipple line. On this date he was given twenty grains of quinine sulphate by mouth, and twelve grains quinine bihydrochloride intravenously. On the 10th he was given two doses of quinine intravenously of twelve grains each and twenty-one grains intramuscularly. On the 11th the apex beat of the heart was inside the nipple line. The signs in the lungs were stationary. His temperature continued high until the 14th, when it fell by rapid lysis. The physical signs at the right base slowly cleared up, but there was still some tubular breathing on his discharge to hospital ship on December 1. Total leucocyte counts were made on November 12 and 15, and showed 15,600 and 6,000 respectively. His sputum was thick, tenacious and rusty.

Case 7.—Pte. N., aged 20, admitted to hospital September 3, 1917. On admission his temperature was 103° F., and benign tertian parasites were

found in the blood. He was put on thirty grains quinine sulphate by the mouth. His temperature fell in twenty-four hours, and remained normal for twelve days. He then complained of severe pain in the left axilla, and his temperature rose to 105° F. Examination of the chest revealed dullness at the left base with bronchial breathing, fine crepitations, and a pleural friction rub. Leucocyte counts showed a leucocytosis of 16,000. The physical signs continued, his temperature remained high for five days, and then came down by lysis, reaching the normal in eight days. The sputum during the attack was typically tenacious rusty sputum. The physical signs rapidly cleared up, and except for diminution of air entry at the extreme base, the lungs presented no abnormal signs seventeen days after the onset of the temperature.

These cases differ in important respects from the previous group. The temperature charts, although not altogether incompatible with a pure malarial infection, are suggestive of a pneumococcal one. The physical signs are not distinctive of collapse, and tend to be much more limited to the affected lobe. There is not the same tendency for them to be associated with diffuse bronchitic signs. The sputum presents characters indistinguishable from that of the true pneumonia, and the cases are accompanied by a definite polymorphonuclear leucocytosis. Further, they do not respond in the same way to quinine treatment.

I consider they represent either an intermittent pneumoccocal infection occuring in a latent or active malaria or superadded infection on the top of a primary malarial change in the lung, although the sections from the collapsed lung which I have examined did show small hæmorrhagic infections, the hæmoptysis which was occasionally seen probably depends on larger infarctions.

I have not seen the type of pulmonary apoplexy rapidly terminating in death described by Armand-Delille, Paisseau, Abrami, and Lemaire.

REFERENCE.

[1] ARMAND-DELILLE, PAISSEAU, ABRAMI, and LEMAIRE. *Le Paludisme*, Macedonian, 1917.

Clinical and other Notes.

A SIMPLE FORM OF FLY-PROOF LATRINE AS USED IN WEST AFRICA.

By Captain A. L. ANTHONY.
Royal Army Medical Corps (S.R.).

A pit is dug in the ground as shown in fig. 1, in suitable soil, to a minimum depth of 15 feet, the pit is 2 feet 6 inches wide at the top and opens out to about 6 feet in width below, that is in sufficiently dry soil. The length is made according to requirements, allowing 2 feet 6 inches of trench for each seat required. The bottom of the trench is then covered with a layer of stones or shale.

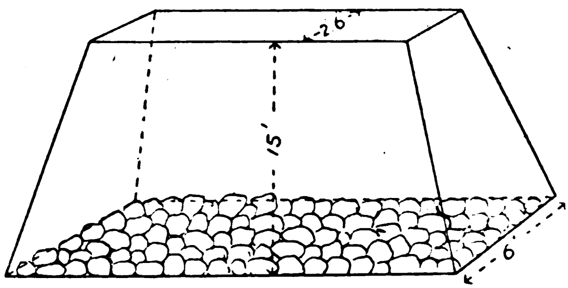


Fig. 1.

Small logs or boles of wood are then cut of sufficient strength (about 4 feet long) to span the trench and bear the weight of several people. These are placed across the trench as indicated by the letters A B in fig. 2. In every 2 feet 6 inches of trench length there is a width of 1 foot 6 inches of the cross sticks, followed by an interval or space of 1 foot.

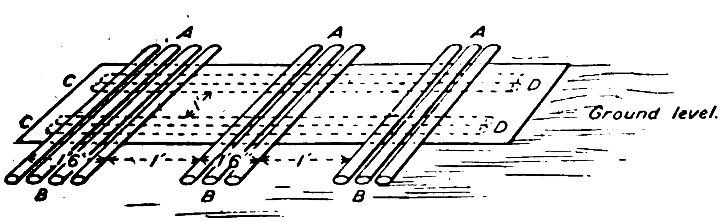


Fig. 2.

More sticks which may be longer are then placed longitudinally along the trench over the cross sticks as indicated between C D, fig. 2. These cover the whole length of the trench and the whole width with the exception of a 1-foot interval in middle. These may now be secured to the cross sticks by a few turns of rope (tie-tie).

The whole is now covered with a mound of earth (wet) of a clay-like nature, leaving only the square 1-foot hole E, fig. 3, where the sticks are absent. The earth is well trodden down and the inner surface of the holes smoothed round.

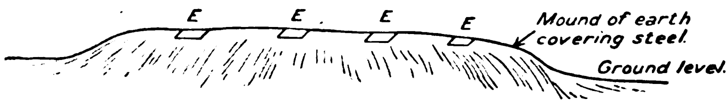


FIG. 3.

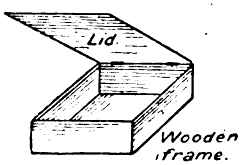


FIG. 4.

Small wooden frames as shown in fig. 4 are now constructed from a few broken boxes and hinged lids fitted. The boxes are slightly over 1 foot square, so as to rest on the upper layer of sticks. They are embedded in wet mud in the apertures, forming a fly-proof roof so long as they are kept closed. The wet mud is given a few hours to dry, and the latrine is then ready for use.

NOTES ON THE USE OF THIS LATRINE.

(1) This latrine does not depend upon its fly-proof lids for its immunity from flies, but upon the depth to which it is dug. It is found in practice that the flies do not penetrate much deeper than 10 feet.

(2) The great depth and capacity of the trench ensures liquefaction of the fæces, and will make natural drainage feasible for many months if necessary.

(3) The soil immediately surrounding the apertures should be given a daily dressing of creosol or preferably izal, and the soil renewed occasionally.

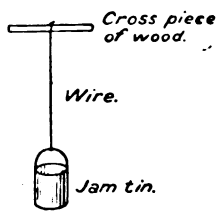


FIG. 5.

(4) The sanitary squad should have instructions to keep a constant eye upon the lids, keep them in good repair and constantly shut when not in use.

(5) The latrine is smoked out daily by means of the simple apparatus shown in fig 5. This consists of a tin suspended by a piece of wire from a small cross piece of wood which rests on the wooden frame, thus keeping the lid slightly open at the time of burning and giving enough oxygen to ensure combustion. A few

embers are placed in the tin and a few pieces of damp wood, and these will smoulder for hours.

(6) Defæcation is performed in the manner natural to the native, and a few palm leaf screens placed round will lend a touch of realism which will prove almost as attractive as his native bush.

NOTE BY MAJOR J. A. BALCK, R.A.M.C.

The latrine described above has been seen by me in actual use in West Africa, and in freedom from nuisance and general cleanliness is in my opinion superior to any other form of native latrine I am acquainted with. It is at my instance that Captain Anthony has written this description, as I think his method well worthy of wider notice than it has yet received. It can of course be easily modified for the use of officers or Europeans generally by substituting for the mere framework shown in fig. 4 a complete box, thus giving a seat.

THE DIAGNOSIS AND ESTIMATION OF THE DEGREE OF NEURASTHENIA BY MEANS OF PERIMETRIC EXAMINATION OF THE EYES.

BY JAMES J. HEALY, M.B., C.H.B.
Ophthalmic Surgeon, Military Hospital.

NEURASTHENIA is in a lesser degree the analogue in this war of enteric in wars of the past; its victims can be numbered by the thousand, both in and out of the army and every day adds considerably to the total. The importance of the disease is being recognized. Hospitals are being established and medical men specially trained to treat the constantly accumulating masses of cases which are so badly hampering our man power and will continue to do so for a period after the war.

Unfortunately the disease (although its general picture is distinct) is more subjective than objective, and in regard to minuter and more tangible details is somewhat vague. Neither is it always easy to estimate the degree to which the disease has progressed nor to differentiate between simulators, of whom there are many and real sufferers. The usual methods of examination are so vague in their results and so lacking in their quantitative estimation that it needs no apology for bringing to notice certain eye symptoms which are capable of being measured, are very unlikely to be simulated and at least one of which in so far as my experience goes is invariably present. Most of the symptoms are known but apparently not widely even to those treating neurasthenia and no attempt as far as I know has been made to introduce systematic eye examination. Unfortunately in this hospital I have not had a very large number of cases. In the course of examination during the past six months of 2,500 ophthalmic out-patients, most of them British Expeditionary Force men, I have come across some undoubted cases of neurasthenia, many border line cases, a certain number of malingerers, and a goodly proportion of hysterias. In addition most admissions to the neurasthenia ward were sent to me for examination; thirty-seven cases of undoubted neuras-

thenia have been examined and the results are so uniform that I feel these methods should be brought more prominently before those who have numbers of neurasthenics under their care, in order that an apparently valuable help to diagnosis be given a wider trial by more capable observers than myself.

Neurasthenia is a disease the pathology of which is misty at present but manifests itself as a derangement chiefly of the nervous and muscular tissues, with a resultant exhibition of easily induced fatigue. One of the most delicate of the nervous and muscular organs of the body is the eye, and it is the one in which small changes from the normal acuity of sensibility can be most readily and accurately measured instrumentally. In the methods commonly used of estimating fatigue much is left to the voluntary effort of the patient, hence cannot be relied upon as a fair test, especially in a patient out to deceive, but in the method of examination here proposed the patient does not know what to expect and is less able to "control" the test for his own ends, at the same time the tests are easily applied, and require no special ophthalmic knowledge and no extensive apparatus.

The cases that come before one display as a rule no gross ocular changes and the symptoms of the disease if they manifest themselves at all in the eye find their expression in asthenopia, hemeralopia, diminution in visual acuity, rapid fatigue of the eyes and headache when reading, or even inability to read at all. I have never seen a case of amblyopia, while photophobia and dazzling only occur after continuous fixation; in hysteria, on the other hand, amblyopia is common, and photophobia, dazzling and pain localized to the eyes are almost constant. Förster found that in neurasthenia the asthenopia manifested itself on perimetric examination by the so-called spiral field of vision and it is for the application of this method of examination of neurasthenia as a routine that I wish to put in a plea. The only apparatus I use is a small portable hand perimeter which is supplied in the Army and is inexpensive.

In applying Förster's test the patient is seated in a chair and holds the perimeter in front of the eye under examination, the crutch below the lower lid, and gazes at the reflection of his eye in a small mirror at the centre of the movable arc, the other eye being shaded. Starting at one meridian the white disk three millimetres in diameter is moved from 90° inwards along the arc until the patient states he can see it moving; this point is plotted on the chart, the arc moved fifteen feet, and the procedure repeated; each meridian is in turn visited, always moving the arc in the same direction either clockwise or anti-clockwise, and when the initial meridian is again reached the circuit is repeated. If during this second plotting the curve tends to approach the centre the circuit is again repeated until the field of vision becomes stationary or the eye amblyopic.

In a normal person the second plotting will be the same as the first, but in a case of neurasthenia it will soon be evident that the points are gradually approaching nearer to the centre of the chart. The rapidity with which this takes place varies as the degree of nervous exhaustion, so that in a marked case the curve may reach the centre and the patient suffer from temporary amblyopia. This gradual contraction of the visual field varies considerably in different cases but the variation seems to me to correspond to the man's capacity for effort. In a very slight case it may be necessary to go round the field twice before a contraction begins to make itself manifest and even then it may not progress very far.

In a case of moderate degree 4 or 5 turns may contract the visual field to 15 or 10, and the contraction make no further progress, while in a marked case one turn or less may contract the field almost to zero. In a mild case if the field for white remains stationary or shows only a slight tendency to contract, the field for blue or red may be examined and if fatigue is present it will be brought out more markedly. In some cases it is found that the fields of colour vision are inverted, but this is not a constant phenomenon, an inversion or interlacing of the colour fields being more usual in hysteria. In some cases of hysteria the field of vision may contract—but in an irregular fashion—and if the test is repeated the second plotting may be larger than the first, or expanded where it was previously contracted, and vice versa; irregular and transient, scotomata are often found. In other cases of hysteria the field of vision is contracted from the beginning and the contraction does not undergo variation on continuation of the test; not only so, if the test be applied on Bjerrum curtain or blackboard the field of vision remains the same size in many cases no matter how far we remove the surface from the eye (the so-called tubular field). Babinski disputes this contraction of the field of vision in hysteria, claiming that it is due to suggestion on the part of the examiner. Experience in this clinic is contrary to this; on first examination without suggestion a contracted field is a very constant result, but if it is then suggested to the patient that he can see the disk further out, it is sometimes possible to enlarge the obvious field of vision, depending upon the susceptibility of the patient to suggestion. There are so many explanations of this phenomenon; probably the most accurate is that the patient is so concentrated on his complaint that his perception through the special sense organs is correspondingly narrowed; but I should like to add one possible help to this end, these patients in an effort to concentrate screw up their eyes and contract their pupils, thereby mechanically narrowing the field of vision.

To return to the subject of spiral fields it may be argued that the fatigue produced is retinal and not central; possibly a small amount of the fatigue is retinal but the following experiment proves conclusively that the spiral curve is mainly due to central fatigue. While the right eye is examined perimetrically the left is shaded. If now the left eye is examined (after a short period for accommodation to the light) it will be found that the field of vision is much more contracted to begin with and that the eye tires more rapidly; allow a few days to pass and repeat the experiment in the reverse order, the secondary contraction will this time be found in the right eye. This was done in a number of cases exhibiting the spiral field and in all the phenomenon was constant. I have now adopted this immediate examination of the second eye as a routine in the investigation of a case of suspected neurasthenia and regard this secondary contraction as the most definite and reliable symptom.

In marked cases diminution in the light sense is exhibited. No Förster's photometer or similar instrument being available, the estimation of this deficiency had to be done roughly; for an examiner, however, with normal or nearly normal vision it should not be a difficult matter to compare on gradual darkening of the room the patient's visual acuity with his own.

The routine I have adopted lately in examining a case of neurasthenia is as follows:—

(1) The visual acuity is noted.

(2) The room darkened gradually and the ratio of the patient's visual acuity to my own is roughly estimated as a fraction (this must be adjusted according to the patient's original visual acuity).

(3) Patient's colour vision is taken.

(4) Field of vision charted as above.

(5) Visual acuity again noted.

(6) Rough photometric examination repeated.

(7) Colour vision repeated.

(8) Same procedure followed out in the other eye.

After perimetric examination the visual acuity may be lessened and if the illumination be diminished may approach amblyopia; temporary colour blindness has also been noticed in severe cases. These symptoms though not constant should be sought for as they are helpful in estimating the degree to which the disease has progressed. On the whole I am inclined to think that the most valuable help to diagnosis and the one sign upon which reliance is to be placed, is the secondary fatigue as tested by the field of vision in the second eye.

Among the cases examined were three who had never been out of this country and who could not be said to be suffering from "battle strain," but were evidently neurasthenic; the fatigue curve was found to be present on examination of these men.

A few cases illustrating the methods above described are appended.

(1) Gunner S.—Examined April 22, 1918; had long spell in France, complains of weakness and headaches. Medical officer can find no organic disease; visual acuity $\frac{6}{6}$ each eye. Retinoscopy at 1 metre plus 1·50 each eye. Fundi normal.

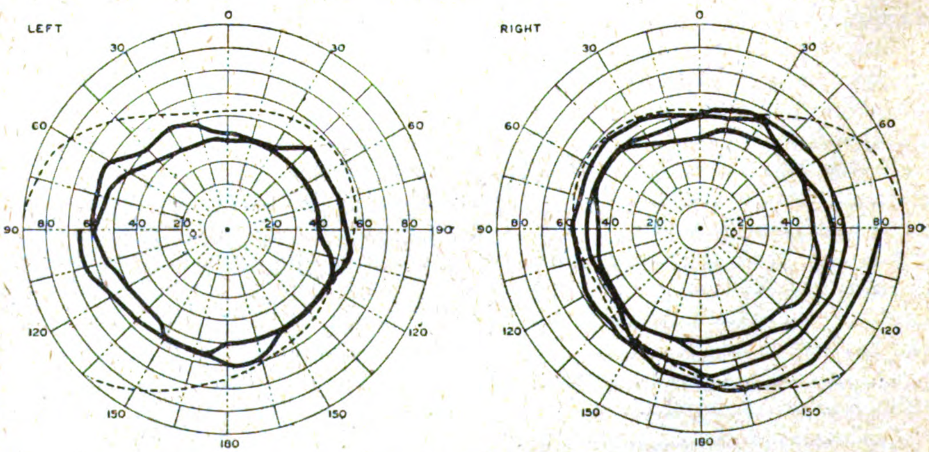


Fig. 1.

Right field of vision shows tendency to fatigue, 4 times round tires from 80 to 50, and remains stationary at the latter. Left field of vision shows slight pre-existing fatigue; tires from sixty-five to fifty, no further contraction, central fatigue present to slight extent.

(2) Gunner, W., R.F.A.—Examined June 13, 1918; has not served abroad, had nervous breakdown before joining the Army; easily tired, exhibits fine tremors of hands and tongue. Knee-jerks + +, visual acuity $\frac{6}{6}$ each eye. Refraction and fundi normal. Right field of vision shows fatigue curve, tires in 5 rounds from 80 to 10. Left field of vision shows marked existing fatigue and tires in one round 60 to 10, moderate degree of neurasthenia.

(3) Pte. E., R.D.C.—Examined March 1, 1918; not served abroad, always been weak; joined R.D.C. as unfit for general service; complains of tired feeling, headaches, constant shaking, cannot see well at night; exhibits deafness, tremors and knee-jerks + +, looks anæmic and anxious; visual acuity $\frac{6}{6}$ each eye; refraction and fundi normal. Right field of vision shows fatigue curve, tires in three rounds from 80 to under 10. Left field of vision shows existing fatigue and tires, from 55 to 10 in two rounds, definitely neurasthenic.

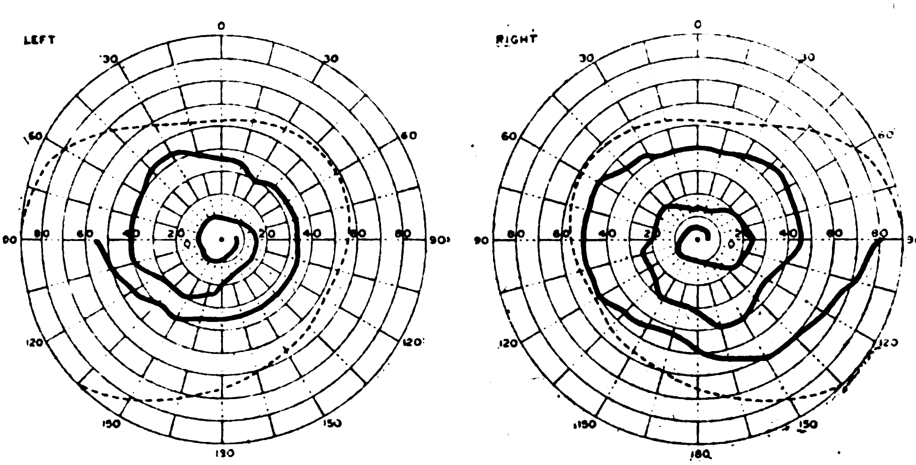


FIG. 2.

(4) Gunner J., R.A. and T.C.C.D.—Examined January 24, 1918; patient in hospital, wounded and blown up in France; complains of headaches, nightmares, insomnia and weakness; tires easily on walking; no organic disease, sent for examination on account of headaches after reading. Visual acuity $\frac{6}{6}$ each eye. Refraction and fundi normal. Right field of vision shows fatigue curve and tires from 80 to 10 in three rounds. Left field of vision shows existing fatigue, tires from 30 to 10 in two rounds, markedly neurasthenic.

(5) Gunner O.—Examined March 11, 1918; examined in bed, served in France, sent home with shell-shock; after prolonged stay in hospital sent to C.D. and admitted to hospital here; suffers from insomnia, easily induced headaches; confined to bed, constant marked tremors, occasional tachycardia but no organic disease. Right field of vision shows marked contraction and exhibits fatigue, tiring from 30 to 0 in one round. Left field of vision shows existing fatigue and tires from 10 to 0 in one round. Visual acuity $\frac{6}{36}$ each eye, and proportionately dropped to half on slightly darkening the room; colour vision normal. After field of vision test visual acuity = $\frac{6}{60}$ each eye; patient colour blind; test re-

repeated four days later in reverse order; fatigue curves reversed, patient very exhausted after examination and complained of severe headaches, severe case of neurasthenia.

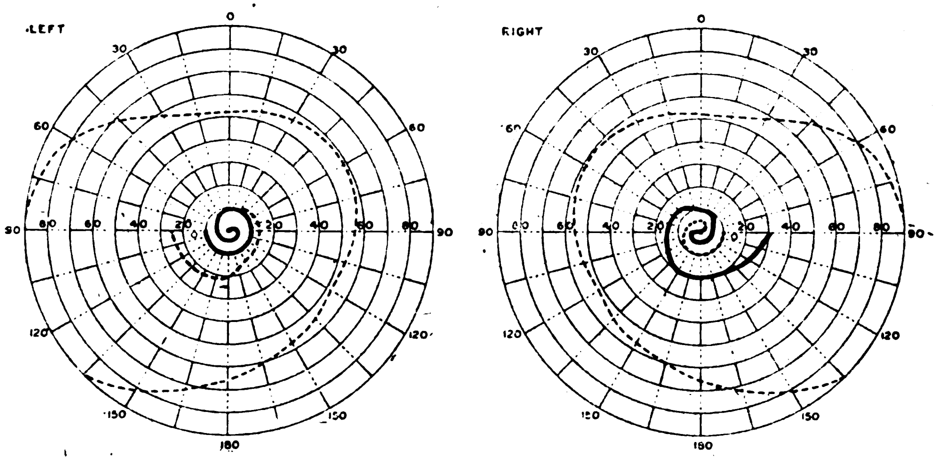


FIG. 3.

(6) Pte. L.—Examined May 10, 1918. Served in France, blown up, sent home with shell-shock; complains of hemeralopia, headaches, insomnia; exhibits tremors; knee-jerks ++, visual acuity $\frac{6}{6}$ each eye. Refraction and fundi normal. Right field of vision some contraction, tires in three rounds from 60 to 20, and then remaining stationary. Left field of vision existing contraction and tires from 25 to 20 in one round; moderate degree of neurasthenia.

(7) Gunner S., R.G.A.—Examined June 10, 1918; wounded right occipito-parietal region November 18, 1917; complains of headache, hemerolopia and insomnia; exhibits tremors, knee-jerks ++, anxious countenance, visual acuity

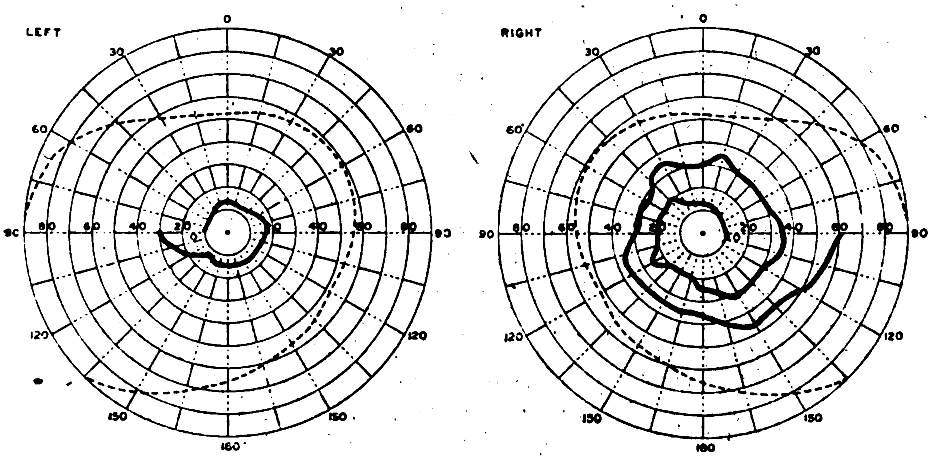


FIG. 4.

$\frac{6}{8}$ each eye, refraction and fundi normal. Right field of vision shows contraction, tires from 60 to 10 in two rounds. Left field of vision shows more marked contraction and tires from 30 to 10 in one round, marked neurasthenia.

These cases indicate the results of examination usually found. In their interpretation the main points to note are:—

(1) The extent of the original field of vision.
(2) The rapidity with which tiring occurs.
(3) The extent to which tiring occurs.
(4) The relation of field of vision of second eye to that of the first.
(5) The obvious state of the patient after the examination.

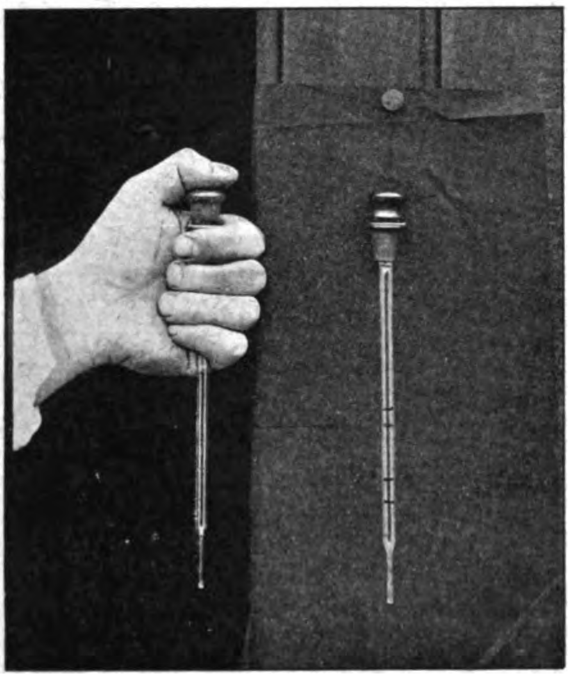
A study of the graphs from these points of view will enable one to understand the condition of the nervous system of the patient, help to a definite diagnosis, and prove a useful aid to prognosis.

I am indebted to Lieutenant-Colonel G. H. Spencer, R.A.M.C., the officer commanding hospital for permission to publish this article.

A MODIFIED TEAT FOR DROPPING PIPETTES.

By Major LAWRENCE J. RHEA.
Royal Army Medical Corps.

The accuracy of the dropping pipette and the comfort and rapidity with which it is used, depends in part upon the ease with which it can be manipulated. This is especially true when it is used often and over comparatively long periods, as in making the dilutions in the agglutinating tests for the enteric group of infections, according to Dryer's method.



The rubber teats provided with the dropping pipettes issued under the direction of the Medical Research Committee, soon lose much of their elasticity, and it then becomes difficult to fill the pipettes to a sufficient extent and to empty them completely.

I have made a simple attachment to replace these teats, which obviates these difficulties. The attachment, which consists of a rubber stopper, and a heavy rubber vaccine bottle cap, is made as follows :—

Bore a hole through the centre of the long axis of the rubber stopper; this hole should be of such a size as to fit tightly over the end of the pipette. Fit a heavy rubber vaccine bottle cap over the larger end of the rubber stopper and fasten it in place by means of a string, small wire, or rubber cement. Rubber cement is not suitable when a solution to be used in the pipette dissolves the cement. The rubber cap should be adjusted so that the vacuum produced is not greater than that required to fill the pipette. A very fine perforation in the centre of the rubber cap makes it easier to prevent the formation of bubbles in the pipette; this perforation may be made with a red-hot needle. A piece of pressure rubber tubing one inch long may be used instead of a rubber stopper.

When a pipette fitted with this attachment is held between the fingers and the palm of the hand, the thumb is left free to manipulate the rubber cap by pressing directly down upon it.

Pipettes fitted with this attachment have been used in our laboratory for some months, and have been found to be more easily and more rapidly manipulated, and less tiring on the hand than when an ordinary teat is used.

The accompanying photograph shows a pipette with its attachment, and the method of manipulating it.

A SIMPLE HOT-AIR CHAMBER FOR USE IN ADVANCED AND MAIN DRESSING STATIONS.

By Lieutenant-Colonel A. H. HABGOOD.
Royal Army Medical Corps.

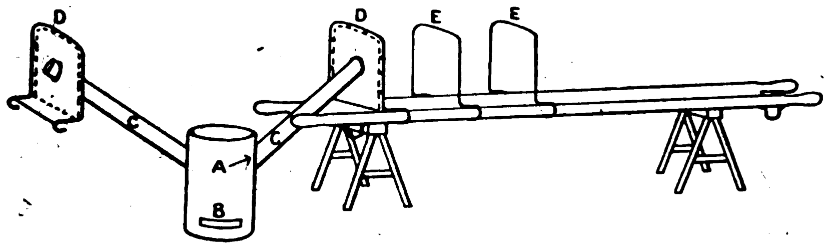
It is now generally recognized that the condition of shock in which a great many wounded arrived at the dressing station is directly connected with cold, and the remarkable improvement which is seen in a pulseless and semi-conscious patient when warmed up is a sufficient incentive to provide warmth at the earliest possible moment.

The hot-air chamber has been used in this unit since the battle of Arras, and models varying somewhat in details of construction have been seen in various dressing stations since April, 1918.

The apparatus as illustrated has proved to be the most efficient model and has the advantage of being very easily made.

"A" is an inverted four-gallon oil drum with a slit "B" to provide air and to enable the wick of a Beatrice stove placed under the drum to be raised or lowered. "C" is a piece of stove piping or tin bent into a pipe which connects the drum with "D," a sheet of tin made from a four-gallon petrol tin. These connexions are loose to facilitate adjustment. The sheet "D" is attached to a Thomas'

suspension bar or aluminium splinting frame and is continued at right angles under the bar towards the stretcher grips. By means of four pipes "C," four stretchers can be heated from the one drum "A."



The suspension bar is placed at the foot of the stretcher so that the right-angled ledge just reaches the canvas, and one or two others are placed at varying intervals along the stretcher.

A folded blanket is placed on the stretcher reaching as far down as the ledge of the plate "D," and a blanket is placed over the bars "D" and "E," tucked in all round, its upper end round the shoulders of the patient.

A patient can be warmed and dried in from about ten minutes to a quarter of an hour, but as the chamber gets very hot in a very short time, he must be watched and the flame of the Beatrice stove adjusted according to the required temperature. This can be done through the slit "B" without disturbing the apparatus.

THE PARAFFIN TREATMENT OF BURNS.

By Lieutenant-Colonel A. J. HULL.
Royal Army Medical Corps.

The introduction of new non-irritating antiseptics has led to several modifications in the paraffin treatment of burns.

Various preparations of paraffin have been made under my direction, containing flavine, brilliant green, chloralamine T., etc., dissolved in the paraffin base. These preparations have been given a very extensive trial. Another direction in which the new antiseptics have given scope for improvement has been the treatment of the burn by an antiseptic before the application of the paraffin. The results following this modification have been so satisfactory that we have adopted it as a routine method.

The method of application of the paraffin base is the same in all cases. The burn is first of all washed with normal saline (1 in 1,000 flavine solution or proflavine has now been substituted). The burn is dried with gauze or an electric drier. A layer of paraffin is applied at a temperature of about 55° to 60° C. A thin layer of wool is placed over the first layer of paraffin, and a second layer of paraffin at the same temperature painted over the wool. A dressing of wool and bandage is applied over the paraffin dressing. The dressing is changed every twenty-four hours. It is important to paint or spray on a sufficiently thick layer of paraffin. If the temperature of the paraffin is too high, the layer is

liable to be too thin. The efficacy of this treatment depends largely upon the mechanical effect of the paraffin. The epithelium is conserved from damage and tissues are held at rest by a splint-like action of the dressing. The addition of antiseptics to the paraffin preparation gave better results than preparations without antiseptics. The first antiseptic to be extensively used was eucalyptus oil, which in conjunction with beta-napthol is still used in No. 7 paraffin. Scarlet red paraffin has given satisfactory results in general use, and has special indications for its use, which makes it a preparation of value. Burns which have been treated with No. 7 paraffin occasionally become sluggish and present unhealthy granulations. We have therefore changed the paraffin to scarlet red paraffin when burns have become clean and shown a tendency to begin to heal. This treatment has resulted in a great acceleration of healing. We have made many experiments with a view to improving the paraffin base, but no preparation has given such good results as No. 7 paraffin. Later a flavine paraffin has been employed; this preparation has been extensively used, and has given satisfactory results. Paraffin preparations of brilliant green and chloralamine T. have not been satisfactory from a pharmaceutical point of view, the antiseptics being difficult to incorporate in the paraffin. Various paraffins of varying degrees of melting point have been tried, but the use of paraffin of intermediate melting point does not produce so good a mechanical base as No. 7 paraffin. The dilution of a high melting-point wax with vaseline and oil appears to have some special value in the treatment of granulating surfaces, and makes a better mechanical mixture. The question as to whether special paraffin, scarlet red or flavine chloralamine T. possess any particular value has been debated. It would appear that, since the antiseptic can be painted on the burn before the application of the paraffin, the use of special paraffin is somewhat unnecessary. The results of flavine applied in the form of solution followed by the application of No. 7 paraffin have been so good that we have practically discarded the use of special preparations, with the exception of flavine paraffin and scarlet red.

The effect upon recovery of the application of various antiseptic solutions previous to the application of the paraffin has been studied.

Eusol.—Accelerated the cleaning of the burn, but was too irritating in its action.

Brilliant Green.—Cleaned the burns well, but if used beyond a certain stage caused light-coloured and unhealthy granulations.

Flavine.—Cleans the surfaces well, whether better than brilliant green is doubtful, but certainly produces a healthier type of granulation.

Scarlet Red.—Is only used when the burns are clean and require stimulation. A ten per cent aqueous solution is painted over the burn before the application of the paraffin. There is very distinct evidence that convalescence is greatly accelerated by the use of this powerful stimulus to the formation of epithelium; one and ten per cent have been tried, and in most cases the one per cent has proved sufficient. Mustard gas burns heal readily by the ordinary application of No. 7 paraffin.

The treatment giving the most satisfactory results, obviating pain, sepsis and other complications, and which we have found generally applicable, is the preliminary painting of the surface of the burn with aqueous flavine solution 1 in 1,000, followed by the application of No. 7 paraffin. In cases of long duration, scarlet

red one per cent is substituted for the flavine solution. We have found rapidity of healing and minimized scarring to be greatly favoured by this treatment.

FORMULÆ.

(1). No. 7—

Resublimed β-Napthol	0·25 per cent
Eucalyptus oil	2 ,,
Olive oil	5 ,,
Vaseline	25 ,,
Paraffin durum	67·75 ,,

No. 10. Red—

Scarlet red	0·2 per cent
Eucalyptus oil	2 ,,
Olive oil	5 ,,
Adeps lanæ hydrosus	4 ,,
Paraffin molle	21 ,,
,, durum	67·8 ,,

No. 11—

Scarlet red 0·2 per cent at expense of paraffin molle. It is difficult to get a good wax which will melt and retain most of the scarlet red.

No. 12—

Brilliant green	0·05 per cent
Eucalyptus oil	2 ,,
Olive oil	5 ,,
Adeps lanæ hydrosus	4 ,,
Paraffin molle	21 ,,
,, durum	67·95 ,,

No. 13. Flavine wax—

Flavine	0·2 per cent
Eucalyptus oil	2 ,,
Olive oil	5 ,,
Adeps lanæ hydrosus	4 ,,
Paraffin molle	21 ,,
,, durum	67·8 ,,

No. 14—

Dichloramine T.	0·2 per cent
Eucalyptus oil	2 ,,
Olive oil	5 ,,
Paraffin molle	25 ,,
,, durum	67·8 ,,

To make a Kilogram of Paraffin.—Take ½ gramme of brilliant green or 2 grammes of scarlet red or flavine or 40 grammes of lanoline, rub up the coloured material with the adeps lanæ hydrosus until a highly-coloured smooth paste is obtained which contains no undisintegrated particles of the dye; using about half an ounce of water assists the solution of the dyes.

Melt the paraffin durum (678 grammes) and add 210 grammes of paraffin molle and 50 c.c. of olive oil. Let the temperature of the resulting mixture sink to at least 65° C., then stir in the previously prepared lanoline paste, stirring until thoroughly mixed.

At about 55° C. add 20 cubic centimetres of eucalyptus oil; stir and allow to solidify.

The adeps lanæ hydrosus is used as a suspending and diffusing agent. Smaller quantities do not satisfactorily take up the dyes. Larger quantities are undesirable, as they make the resultant wax less satisfactory to paint on. If the above directions are followed, little of the dye falls out of suspension, although reheating the wax for use tends to make this occur. Unless small quantities of wax are melted at a time, it is advisable to stir the liquid before using. The scarlet red forms the least satisfactory suspension, and requires stirring while using, but its therapeutic value has caused it to be persevered with.

To prepare Dichloramine T. Paraffin. — Dissolve the dichloramine T. in eucalyptus oil and add to the other ingredients at 55° C.

The dichloramine T. wax has proved an unsatisfactory wax from a practical point of view, owing to the tendency to be brittle and adhere to the raw surface of the burn, instead of being easily removed in one piece, as is the case with the other preparations.

POROCEPHALUS IN A HERNIAL SAC.

By Captain J. W. TUDOR THOMAS.
Royal Army Medical Corps.

The occasional occurrence in man of developmental forms of a porocephalus has been known for a considerable time, but recorded cases of the finding of such forms are by no means common; and as far as I am aware from the perusal of the literature at my disposal in this country, such examples as have been found have been obtained at autopsies. It is therefore of interest to put on record the finding of one of these larval forms in a living man.

The patient was a West African negro soldier who had come to this country from the Gold Coast. He suffered from an ordinary right-sided inguinal hernia, which he was anxious to have cured by operation. On cutting down, the sac was found to be very thickened by fibrous tissue and contained omentum.

On opening the sac, a larva was found coiled up in the sac wall and covered over by a thin transparent lining membrane. This specimen was submitted to Lieutenant-Colonel Newman, R.A.M.C., Consultant in Tropical Diseases to the East African Forces, who stated that the larva was that of a porocephalus. The patient from whom it was taken complained of no symptoms pointing to the possible presence of further larvæ in the liver or elsewhere, and made an uninterrupted recovery from the operation.

Lecture.

SOME PROBLEMS OF THE CIRCULATION DURING GAS POISONING.[1]

By JOSEPH BARCROFT, C.B.E., F.R.S.

Introductory.

Perhaps I can best commence the lecture which I am about to give by defining the limits of the subject. In one sense these limits are very narrow ones. Were I to lecture on the general pathology of gas poisoning, the subject would be too wide for treatment within the space of an hour, so I must restrict it; and the first restriction I shall make will be to consider only the case of pulmonary irritant gases, and principally phosgene and chlorpicrin. Yet even the general effects of these gases would be too much; so discarding all questions of their effect on the respiration, I shall consider their effect on the circulation, and only refer to the respiration incidentally, for of course the circulation and the respiration cannot wholly be divorced the one from the other. Yet even now there are other restrictions which I shall place upon myself, for I shall only put before you such information as has been gleaned from objective experiments in animals, and of these only such as have been conducted under my own supervision and of which therefore I am able to speak to you as at first hand.

So it may seem to you that after entering on a subject which presents a very large opening, I have reached even before the commencement a very restricted space, that I have travelled down a sort of intellectual funnel and that I am going to discuss something extremely narrow. It may be so: but at least I may put forward this defence, that the longer I worked at gas poisoning, the larger loomed the circulatory problems involved; and the more definite the point under discussion, the better pleased was I to have as the subject of my experiments animals which could at any moment be killed, so that by actual inspection post mortem we could see just what condition of affairs gave rise to the symptoms which we observed.

Let me then restate the title of my lecture at greater length than was possible on the syllabus. I propose to lecture on that *part of the pathology of poisoning with pulmonary irritants which concerns itself primarily with the circulation as evidenced by experiments carried out on animals in the physiological laboratories of the Royal Engineers' Experimental Ground at Porton.*

The experiments performed were, roughly speaking, divided into two categories: field experiments and chamber experiments. Chamber experiments were those in which the animals were exposed to known concentrations of gas in a chamber of glass for measured times. These animals were therefore at our disposal for study, so that any information of a kind useful to the Army Medical Service might not be lost.

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[1] Lecture given at the Royal Army Medical College on October 15, 1919.

PART I.—HISTOLOGICAL.

So much by way of preface, and now to pathology. I have already stated that the great advantage under which we worked was that at any time we could, by killing our animal, see exactly what the pathological condition of its lung was. We can therefore make a fairly complete statement as to the series of changes which took place from the time that any lung was gassed until the time at which it was examined. Let me then run quickly over the succession of events as they are shown in a gassed goat's lung.

The severity of the affection depends upon the dose of gas. Let me assume that the degree of gassing is somewhere near the fatal limit—not so bad as to cause certain and rapid death, but bad enough to be a severe case.

The first point which I would emphasize is that if the animal has recently been gassed the whole lung is affected, but it is not all equally affected. Suppose we choose for examination a period within the first three hours after gassing.

The lung is red, instead of its usual pale pink colour. By the end of half an hour the main lines are indicated on which pathological changes will proceed. In Dunn's words, [1] "the cardinal feature is the damage of the capillary blood-vessels in the zone where these are first exposed to the gas, with no greater protection than is afforded by the delicate pulmonary epithelium." And so we are face to face at the outset with the vascular changes which take place.

The damage to the capillaries may be of two degrees of severity.

The greater degree manifests itself as intra-capillary thrombosis with complete stoppage of the circulation; the lesser degree as increased permeability of the walls, causing what is the most marked change to the naked eye, an outpouring of œdematous fluid, most marked in the connective tissue spaces of the lung and less marked but present as a trifling amount of fluid which appears in the alveoli.

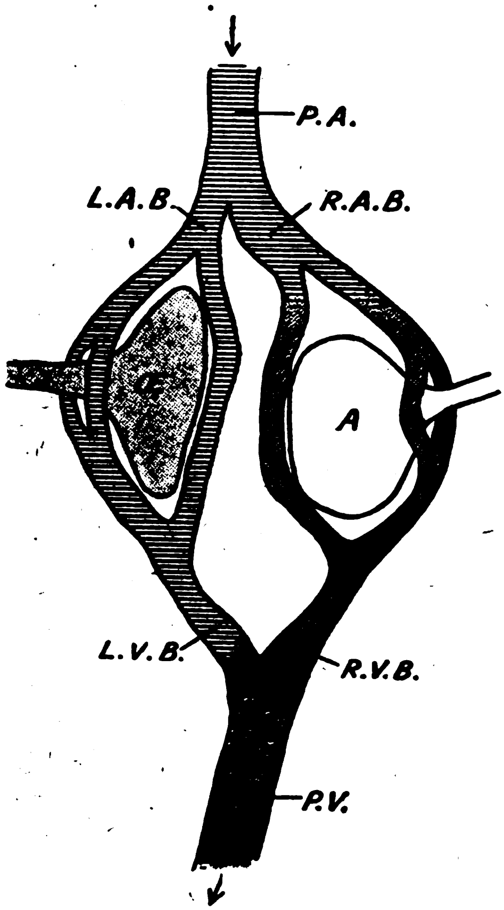
The second stage of gas poisoning sets in about the commencement of the fourth hour; in it the œdema rapidly increases. On the day after the poisoning the weight of the lungs may be up to four, or even six times the normal, so full are they of fluid.

The pathology of gas poisoning has to me been full of surprises, but never was I more surprised than when I discovered that it was possible for a goat to live with its arterial blood fully, or almost fully, oxygenated, but with its lung four times the ordinary weight. The explanation of this remarkable phenomenon is revealed by a study of the blood-vessels. From this point the pathology of gas poisoning assumed a new light. I had previously been asked why do the poisoned animals die? I now asked myself the much more difficult question, why do they live? The key to this situation lies in the fact that the blood almost ceases to circulate in the completely œdematous portions of the lung. Let me convince you of the fact first, then let me dwell for a moment on its significance.

I have already pointed out that in the third hour or even before it, some but not a great quantity of the capillaries were completely plugged whilst the walls of the rest of the affected area were injured. The slide (No. 4) which I am about to show you is very instructive. It represents two portions of the same lung: they are however unequally œdematous, the top portion of the left hand section (4*a*) being relatively free from œdema, the right hand portion (No. 4) is completely full of fluid. This however you cannot see from the slide because the only things

which are evident on the screen are the blood-vessels. The lung has been injected through the pulmonary artery: it is one of many which were done at Porton, and it was done by a practised hand. We were satisfied that it gave a true picture of relative permeabilities of the capillaries in the two portions to fluid.

The vessels in the functional portion of the lung are injected and those in the œdematous portion are not. That at least is an impressionist view and on that impression I will dwell whilst I explain its significance.

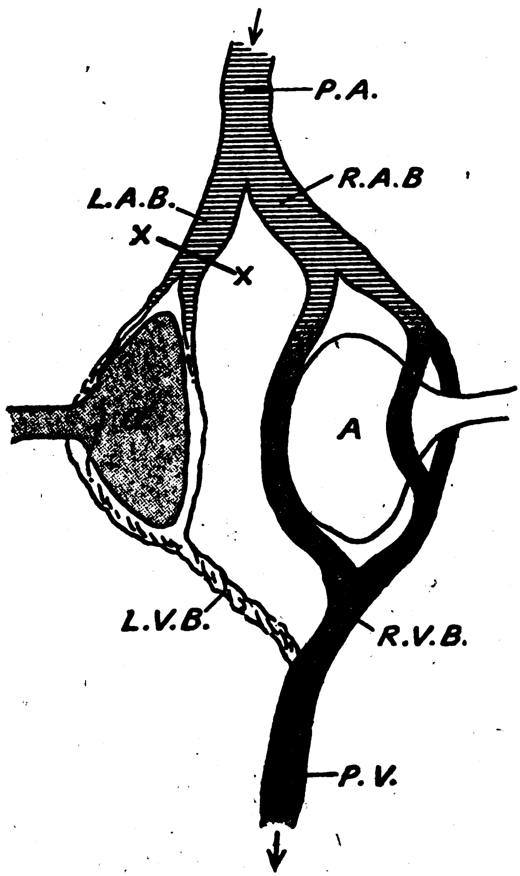


SLIDE 5.—Diagrammatic scheme of circulation through functional and œdematous portions of the lung. P.A., pulmonary artery. L.A.B. and R.A.B., branches of same. Œ., œdematous alveolus. A., functioning alveolus. P.V., pulmonary vein. L.V.B. and R.V.B., branches of same.

This I can best do by a diagrammatic sketch (Slide 5). In this scheme before you I will work from the top of the slide downwards. PA represents a branch of the pulmonary artery; it bifurcates; the left branch goes to some alveoli which are filled with œdematous fluid (Œ), the blood has no chance of being aerated and emerges towards the pulmonary vein the same dark colour as it entered by the pulmonary artery, and so we find it at LVB: the right branch of the arterial

bifurcation (RAB) goes to open alveoli, the blood becomes oxygenated to the normal extent of arterial blood and emerges in the right venous bifurcation (RVB) bright red in colour.

Of what nature then is the blood in the pulmonary vein (PV)? It is a mixture of the red blood from the aerated side and the black blood from the œdematous side. In other words, it is dark, bad blood, though not so dark, or so bad as that in the pulmonary artery. Now as the whole of respiration is directed to one purpose, namely, the aeration of the blood, it is clear that the respiratory process has miscarried in the above scheme.



Slide 6.—Diagrammatic scheme of circulation through functional and œdematous portions of the lung. P.A., pulmonary artery. L.A.B. and R.A.B., branches of same. Œ., œdematous alveolus. A., functioning alveolus. P.V., pulmonary vein. L.V.B. and R.V.B., branches of same. X—X, point of occlusion of vessel.

Such would be the result if the alveoli became œdematous whilst at the same time the circulation remained normal. Imagine now a clip, X—X slide 6, placed at LAB so that blood ceases to traverse the vessels on the left side of the picture. But one path now leads from PA to PV, it is via RAB and RVB. In other words,

the whole of the blood which reaches the left side of the heart and is passed into the systemic circulation is now of the normal bright red colour. So far as the quality—and this is the important point—of the blood goes the respiration is normal and efficient.

If the cardinal features of the damage to the lung are to be found in the capillaries sometimes within the first half hour, so the cardinal principles of repair are to be found in the capillaries also sometimes in the first half day. So we enter on the third stage of gas poisoning, that of resolution. Occasionally as early as the twelfth hour, but more usually about twenty-four hours after gassing, a change for the better commences.

The lung begins to clear up on a definite and now well ascertained principle which is merely an expansion of what I have already put before you and for which your minds will therefore be prepared. Heretofore the whole lung had been more or less involved, part more, and part less. These two parts now become completely differentiated; the part that is more involved becomes temporarily but absolutely condemned, the part which is less involved clears up at once. And therefore you have the type of lung which is shown in the slide (No. 7) in which these two parts are clearly marked off from one another. Anatomically it consists of two descriptions of tissue, the one practically normal lung with patent alveoli and free circulation, the other absolutely functionless, the alveoli being filled with solid œdema, the circulation restricted to the passage of the bare minimum of blood necessary to maintain the life of the hepatized tissue. Physiologically this lung supplies admirable blood to the body.

If I have left you with a clear idea of the differentiated lung, and an understanding of its significance, I have accomplished what I set out to do in the first part of my lecture, and I will therefore pass on to another aspect of the problem.

Part II.

Do I hear someone say: You have shown how complete differentiation of the lung preserves the quality of the arterial blood; but does it not do so at the expense of the quantity? If you cut off half the blood-vessels, do you not cut off half the blood? In fact, is there not abundant evidence from clinical cases of the most painful description that cutting off the blood from one lung, as when a clot is caught in the pulmonary artery on one side, is fatal?

First, let me put before you a general statement of the first importance. The lung is made to pass in exercise many times the quantity of blood which traverses it during rest. So far as the needs of the body go, therefore, the whole of the lungs are quite unnecessary for the purposes of sedentary existence. The effect of cutting down the quantity of available lung is to restrict the activity of the individual without deteriorating the quality of the blood. If the patient be in bed, an ample quantity of aerated blood traverses his lung but he is incapable of any considerable exercise.

Having made this general statement, I must now admit that I myself was at one time greatly impressed with the criticism under consideration. I reasoned as follows: Suppose you consider some simple hydraulic model of the circulation—such as the one depicted on this screen (see lower portion of slide 10).

It consists of a pump, which represents the heart; this pump is fed with water

instead of blood. The water is pumped to the right along a piece of rubber tubing —the "pulmonary artery"—and then through two glass tubes packed with sponges. The tubes represent the lungs, and the sponges (or rather the cavities between and through them) the small pulmonary vessels. Finally, all the water which is pumped through this system flows into a graduated cylinder, in which it can be measured. Besides measuring the quantity of fluid which passed through the system, I wished also to measure the pressure at which it was delivered into the "pulmonary artery." I therefore attached a pressure gauge, in the form of a recording mercurial manometer, to the "pulmonary artery" by means of a piece of rubber tubing let into the wall. There are two quantities now which I can measure —the pressure in the model artery, and the quantity of fluid delivered into it per minute; the latter I shall allude to as the "minute volume." They are important individually and they are important jointly, because their product gives the work done by the "heart."

The question before us is: What will happen to the arterial pressure, the minute-volume, and the work respectively if half the model lungs are completely put out of action? The answer is shown on the screen. The tracing is the record of arterial pressure. At the commencement of the experiment the pressure was thirty-four millimetres of mercury on the average. The minute volume was 200 cubic centimetres per minute; the work done by the pump was 0·08 kilogram-metre per minute. This was with perfectly free passage of water through the "model lung" systems. At the point indicated by the arrow, one of the two sets of sponges was cut out by closing the clip; apparently it was the one through which more than half the water flowed. This was done in imitation of the putting of half the lung, or more than half, out of action in the manner described in Part I.

And what actually happened was as follows:—

(1) The arterial pressure rose from 34 to 110 millimetres.

(2) The minute volume fell from 200 to 160 cubic centimetres per minute.

(3) The work done by the pump rose from 0·08 to 0·23 kilogrammetre per minute.

With such an experiment in mind, it seemed that if the vessels in a great proportion of the whole pulmonary system were closed, one or both of the following things would happen: either the pressure in the pulmonary artery would rise, or the minute volume would fall. Either of these happening would greatly tax the heart by increasing the work thrown upon its right side. On such a theory you could readily account for a great deal of what happens in gas-poisoning.

I naturally turned for confirmation—or otherwise—of this mechanical scheme to the work of Professor Starling on the less mechanical heart lung preparation. I say less mechanical because while the lungs in the heart lung preparation are as passive as the sponges, the heart is not as mechanical as the pump; it has the capacity of varying its power to meet the circumstances of the case.

I did not find an exact analogy, but there were two experiments of Starling and Fühner's [2] in which the principles at stake appeared to be those involved in the experiment which I have just described although the details were different. In both cases the ratios of the minute volume to the bed through which the blood was propelled was increased.

In the first case Fühner and Starling increased the resistance in the lung, not as we did by completely closing some of the vessels, but by partially closing

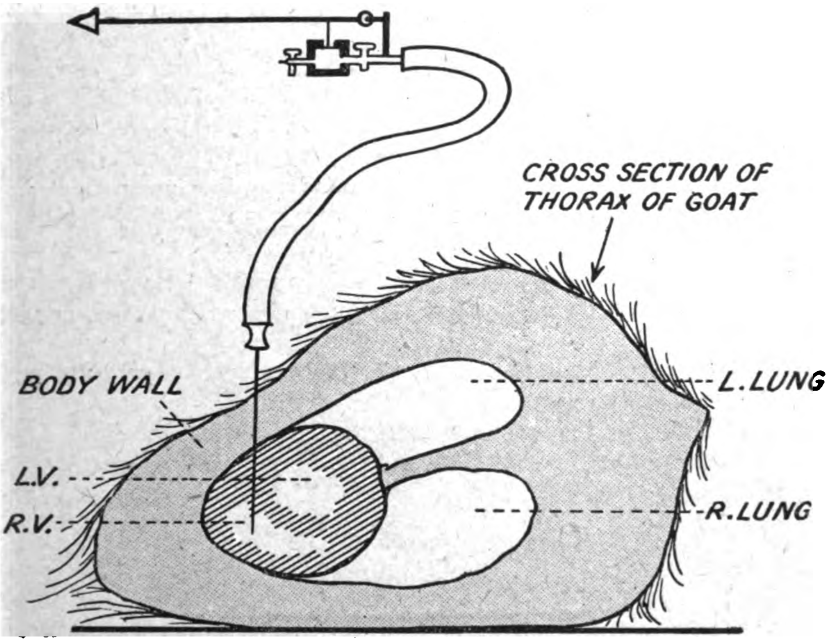
all the pulmonary vessels. This they did by the injection of adrenalin into the pulmonary artery of the heart lung preparation. The result was as follows :—

(1) As in the tracing which I showed you, there was a rise in the pressure of the pulmonary artery which rose from twenty-four to fifty centimetres of water.

(2) The minute volume fell from 300 to 267 cubic centimetres.

(3) The work rose from 0·07 to 1·3 kilogrammetres per minute.

The second experiment of Starling and Fühner to which I would refer is one in which again the ratio of the volume of circulating blood to the vascular area through which it circulated was increased, not by cutting down the size of the vascular bed, but by increasing the quantity of blood pushed through it. The results were just what might have been anticipated from the experiments already



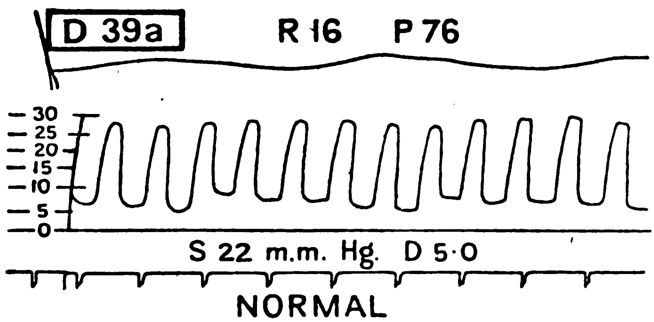
Slide 12.—Diagrammatic scheme for measurement of intracardiac pressure in intact animal by direct puncture.

described—increased pressure in the pulmonary artery and increased work. It was not a difficult matter to test the theory that occlusion of the pulmonary vessels in gas poisoning caused high pressure in the pulmonary artery and overloading of the right heart.

At Porton we had found out how to do a number of things by the simple process of introducing a hypodermic needle direct into the heart. [3] This procedure, as was told by Boycott, was known to pathologists, for the purpose of making injections. We invoked it to attain many other ends, most of which depended upon the withdrawal of blood or the determination of intracardiac pressure.

A goat is chosen, a hypodermic needle is passed through the body wall in the third intercostal space so that the point enters the right ventricle. For the

measurement of intraventricular pressure the needle is then connected with a recording tambour by tubing filled with fluid. Every pulsation of the heart causes a rise on the record. The top of the record therefore shows the systolic pressure in the right ventricle, which is in essence the pressure in the pulmonary artery. The bottom of the record shows the diastolic pressure, which of course varies with the venous pressure.

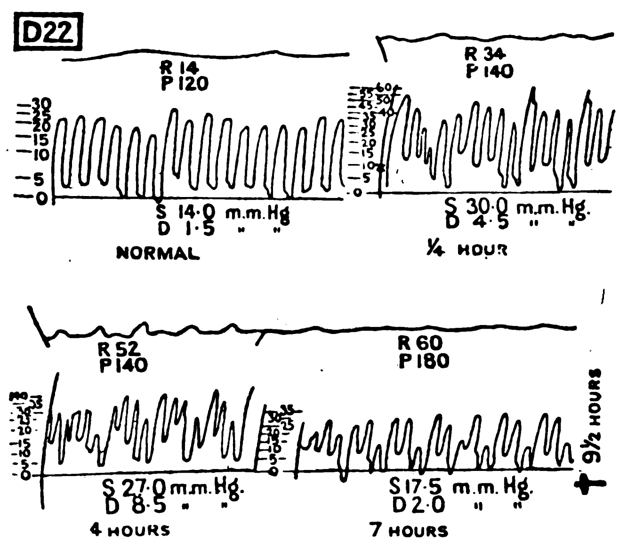


Slide 13.—Tracings of respiratory rhythm and normal right intraventricular pressure. R., respiration. P., pulse. Vertical scale, pressure in centimetres of water. S., mean systolic, and D., mean diastolic pressures. Time, seconds.

Now to return to the theory that in gas poisoning a high pressure is produced in the pulmonary artery owing to the closing up of a great proportion of the vessels in the lung.

What then was the result of our tests? Did the systolic pressure go up, or did the blood volume go down?

Nothing could appear more chaotic than the figures which we obtained. To place them before you :—

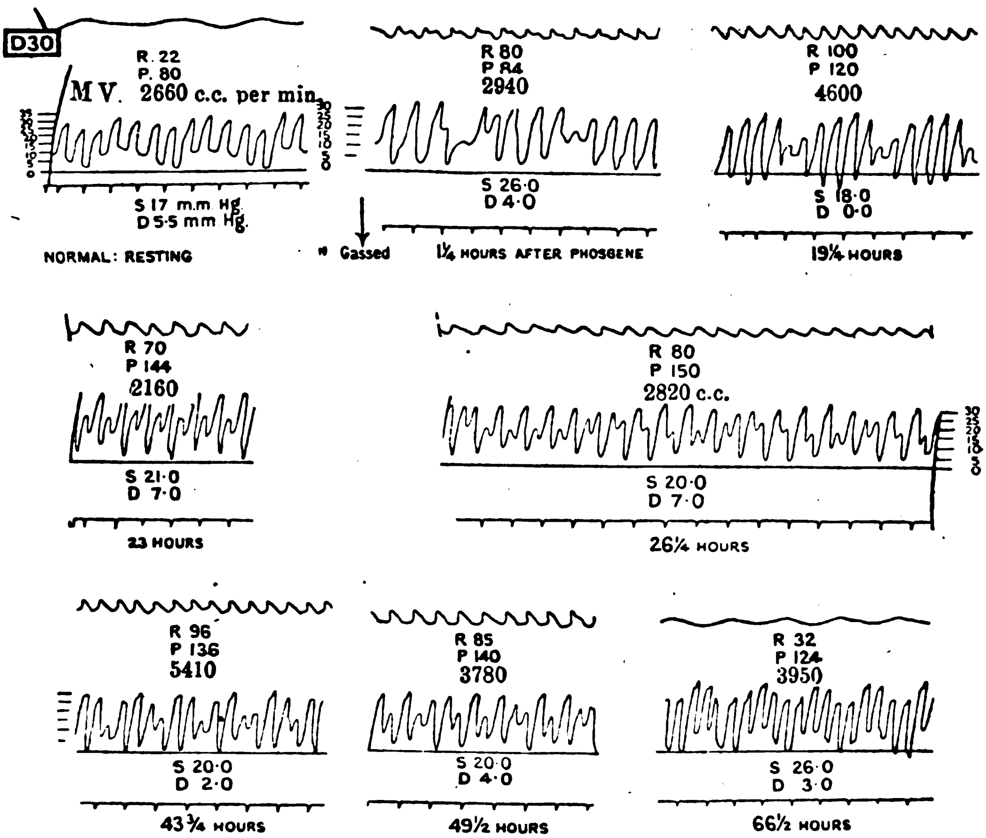


Slide 14.—Tracings of respiratory rhythm and normal right intraventricular pressure. R., respiration. P., Pulse. Vertical scale, pressure in centimetres of water. S., mean systolic. and D., mean diastolic pressures.

(1) Sometimes the systolic pressure rose considerably just as I had expected it to do, but this was the great exception.

An example in point is given in slide 14. The normal systolic pressure being fourteen millimetres, it rose to thirty millimetres, or double its original value, fifteen minutes after the animal was gassed. This was in an animal badly gassed which died in under ten hours.

More typical I think is experiment D 30, a record of which is shown in



SLIDE 15.—M.V., minute volume. Tracings of respiratory rhythm and normal right intraventricular pressure. R., respiration. P., pulse. Vertical scale, pressure in centimetres of water. S, mean systolic, and D., mean diastolic pressures expressed in mm. of Hg. Time, seconds. For method of measuring minute volume see *Quarterly Journal of Medicine*, p. 35, October, 1919.

slide 15. In this experiment the animal which recovered was kept under observation for three days. In the first record after gassing there was an appreciable rise of pressure, amounting to fifty per cent of the normal so that the series of records obtained in this experiment shows the following points of resemblance to and of dissimilarity from the artificial scheme.

Like artificial scheme, a rise of pressure of from seventeen to twenty-six millimetres.

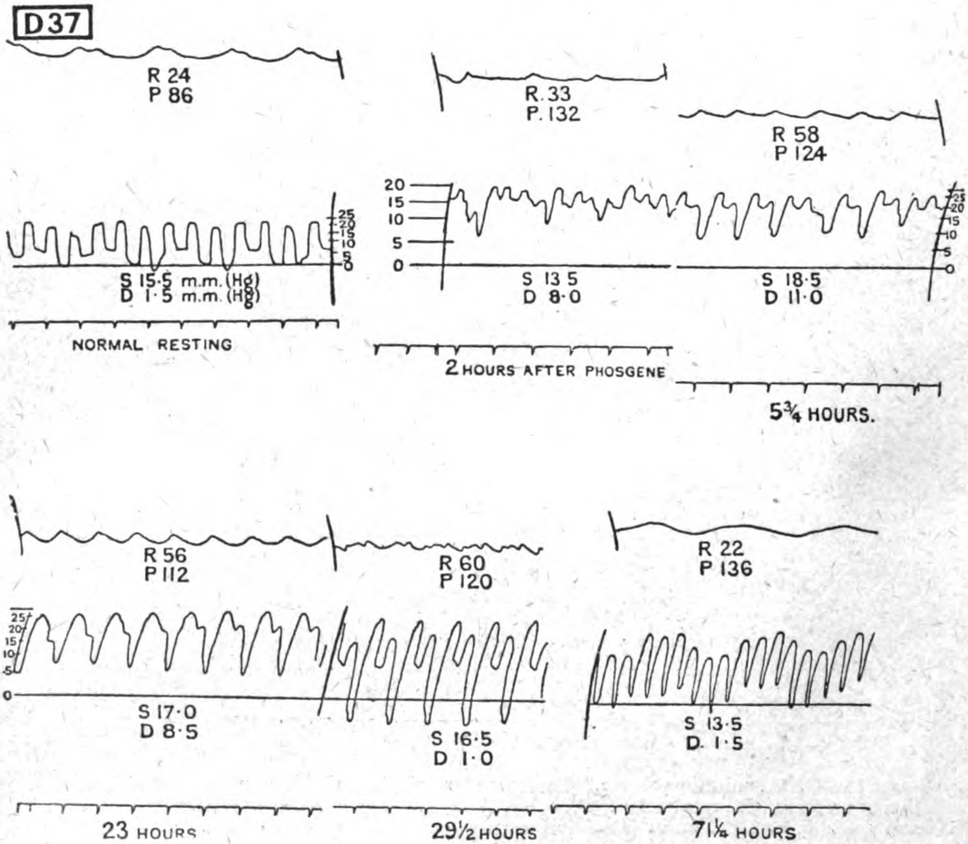
Unlike the artificial scheme, a rise of minute volume, [4] from 2·6 to 2·9 litres.

Like the artificial scheme, an increase in the work, 6 millimetres to 10 millimetres per minute.

The divergence from the artificial volume here was that the heart had risen to the occasion, keeping up the minute volume.

In the case of the experiment shown above the systolic pressures were :—

Hours after gassing	Normal	$1\frac{1}{4}$	20	23	26	44	50	67
Systolic pressure	17	26	18	21	20	20	20	26
Minute volume (litres)	2·7	2·9	4·6	2·2	2·8	5·4	3·8	4·0
Worth km. per min.	6	10	11	6	6	15	10	14



SLIDE 16.—Tracings of respiratory rhythm and normal right intraventricular pressure. R., respiration. P., pulse. Vertical scale, pressure in centimetres of water. S., mean systolic, and D., mean diastolic pressures expressed in mm. of Hg. Time, seconds.

Even here it was only in the first period after gassing, and in one at the very end, that the rise was outside the range of momentary variation, and at most it was small as compared with what might easily be obtained in other ways.

Twenty-four hours after the gassing, at the time when the lung was differentiated into relatively normal and relatively bloodless portions, the pressure and the minute volume were both fairly normal.

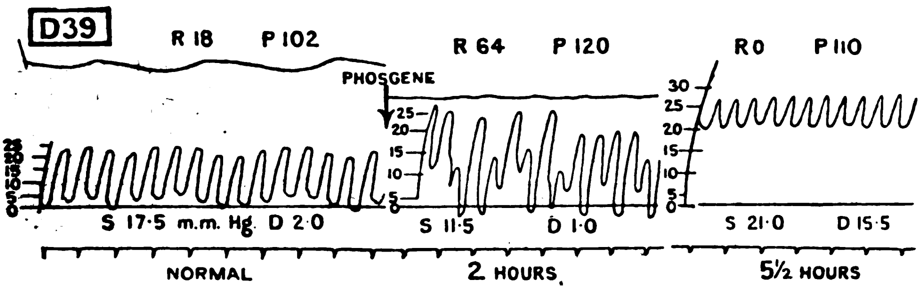
(2) At one point the minute volume fell to a marked degree, but never continuously through a whole experiment, the fall commencing with the closing of the vessels and returning to normal when the whole lung cleared up. I attach a good deal of importance to this slowing of the blood circulation, but in quite another connexion, and in this one we may put it out of our minds.

The most common result, however, was one in which there was no appreciable rise in systolic pressure—an example is shown in slide 16.

This animal, though subjected to a heavy dose of gas, was in fact a light case of gas poisoning. The pressure and minute volumes were :—

	Before gassing					
Hours after gassing		2	5¾	23	29½	71¼
Systolic pressure, mm.	15·5	13·5	18·5	17	16·5	13·5
Minute volume, litres	3·3	3·8	3·6	3·7	4·6	3·1

There were, however, severe cases which showed equally little rise in arterial systolic pressure, so long as the animal was alive, i.e., so long as respiration was maintained, as shown in slide 17.



SLIDE 17.—Tracings of respiratory rhythm and normal right intraventricular pressure. R., respiration. P., pulse. Vertical scale, pressure in centimetres of water. S., mean systolic, and D, mean diastolic pressures expressed in mm. of Hg. Time, seconds.

So far as we can make any summary of the above cases, it is that a marked rise in the systolic pressure does not occur after the commencement of the second hour and by no means always before it. It therefore does not occur at the time of marked differentiation of the lung and closing large vascular tracts.

In this the gassed animal differs from the artificial scheme. It differs from the artificial scheme, also, in that the minute volume does not usually show any fall at the time when a systolic rise does occur. Nature had clearly eluded us.

Two courses of action were now open to us : firstly, to give the investigation up as hopeless ; secondly, to attempt some sort of analysis of the situation.

The former course would have been much more easily justified under war than under peace conditions, for the quantity of pressing work to be done was always more than my staff could accomplish.

I took the responsibility of not putting this problem aside for others, but of attempting some further analysis.

There are two obvious ways in which such an analysis might be made. They are : (1) To correlate the vascular conditions with the time ; (2) to correlate them with the gravity of the complaint. It is the latter method to which I wish to call your attention just now.

You may argue somewhat in this way: Granted that, with a gassed lung in which many of the vessels are occluded, you may get one of two conditions in the pulmonary artery: (*a*) a rise in systolic pressure communicated from the right side of the heart; (*b*) an unchanged systolic pressure; which of these represents greatest departure from the normal? Can we put them in any order in which we can say one represents the least abnormal condition of the animal, another represents the most abnormal condition?

In order to formulate some sort of answer to this question it is necessary to state what the conditions in the normal lung are. But these conditions were unknown. Our object then was to investigate them.

In the normal the partial closing of the vascular bed of the lung may be attained by the injection of some material, such as starch or oil, into the jugular vein. The grains of starch or the globules of oil pass through the right side of the heart and lodge in the pulmonary arterioles [5]. For the first few minutes after the injection the circulation is considerably upset, and if the amount injected is excessive the effect is of course fatal. No doubt such a case is analogous to that of a clot which proves fatal on reaching the pulmonary circulation on one side. If, however, the dose is short of being a fatal one, the upset due to the first shock passes off and the animal returns to a stable condition.

Slide 18 gives four successive changes in intracardiac pressure during oil embolism. I ask you to note:—

	Time		
(1)	5.45 p.m.	.. The normal tracing with an average systolic pressure ..	18 c.c.
(2)	5.52 ,,	.. After injection of two cubic centimetres of oil, systolic pressure	18 ,,
(3)	5.54 ,,	.. Injection of three more cubic centimetres of oil ..	23 ,,
	5.55 ,,	.. A transient rise	
(4)	6.0 ,,	.. Minutes subsequently systolic pressure	17 ,,

The next slide is of starch embolism, and here you will see that even the transient rise after the injection has eluded the observer.

Time relation to production of embolism	Before	5 minutes after	80 minutes after
Systolic pressure mm. ..	15·6 ..	8·5 ..	13

There is no doubt about the lodgment of the oil and the starch respectively. Post-mortem examinations show the blockage of the circulation to have been very great in each case. Indeed, in that of the starch one can affirm that the whole of the potato starch used was held up in the lung.

If this rise of pressure in the pulmonary artery then was but transient, what could be said about the quantity of blood which traversed the lung.

The following tables show the "minute volume" before and after embolism:—

	Minute volume in goat before embolism	Minute volume after embolism
First estimation ..	1·4 litres ..	50 minutes after, 2·0 litres
Second estimation ..	1·5 ,, ..	70 ,, ,, 1·6 ,,
Third estimation ..	1·2 ,, ..	—

In four experiments performed two showed a fall in the minute volume and two a rise. There was therefore no constant effect which could be attributed to the embolism.

One experiment, however, I must mention especially, for in it the minute

volume was measured both *immediately* after, and, as in those quoted above, some time after the injection of starch.

Minute Volume		
Before embolism	11 minutes after	1·5 hours after
2·6 litres	0·9 litre	2·9 litres

It would seem in the case of the minute volume, as that of the systolic pressure, there is a transient effect, such as would be observed in a mechanical scheme, or in the heart lung preparation—but that this soon passes away. The normal animal has some means at its disposal for the correction of the purely mechanical results which would follow from the blockage of the lung vessels—some form of compensatory mechanism.

I will leave the *mechanism* of this compensation on one side and dwell for a moment upon the fact. The principle which we seem to have discovered is too important to let slip. The mechanical is the abnormal, normality is the defiance of the mechanical. So only can the conditions of the body be stablized. This principle must be further tested. In the experiment on embolism we reduced the area of the capillary bed in the hope of obtaining a rise of pressure in the pulmonary artery similar to that which we had obtained in our pump scheme, and we failed, just as we had failed in gas poisoning. The scheme therefore having played us false, what help can we obtain from the less mechanical heart lung preparation?

In one experiment of Fühner and Starling to which I called your attention, the minute volume was increased and the pulmonary pressure rose. Can we increase the minute volume in the normal goat, and observe the result on the right systolic pressure? Certainly. Increased minute volume normally results from exercise. It is only necessary to observe the intracardiac pressure on the right side, before and after exercise, in order to obtain an answer to the question.

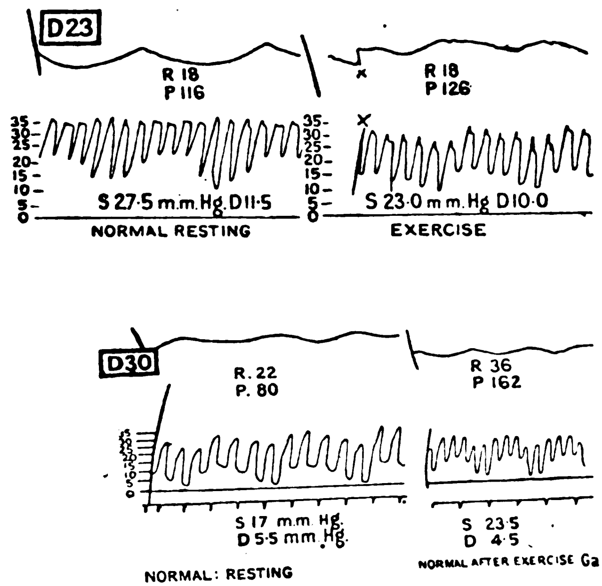
Tracings from two such experiments are given in slide 20.

In the first there is a fall of systolic pressure from 27·5 to 23 millimetres, in the second a rise from 17 to 23·5, accompanied by an approximate doubling of the minute volume.

In the case of exercise then, as in the case of embolism, the blood-pressure in the pulmonary artery is stable in spite of variations of minute volume or of the number of vessels which are available in the lung for the transport of blood.

To pass from the fact of the stability of pulmonary pressure to the mechanism by which it is stabilized. Naturally one asks oneself what is the essential difference between the living chest, and the heart lung preparation. There are two obvious differences. Firstly, the thorax is always in the natural state of respiration. There can be no doubt that the respiratory movements are a potent accessory factor in driving the blood through the chest. The subject is a very large one—a whole lecture might easily be devoted to it. But a study of the tracings would I think convince you that some more specific factor than the respiratory movements is the cause of the remarkable constancy of pressure which we have observed, in the normal, and usually in the gassed animal. Nor is this specific stabilism far to seek, for does not the second great difference between the heart lung preparation and the intact animal lie in the fact that the latter has a nervous system which is the great co-ordinator of the individual processes.

That there were vasomotor nerves to the lung was once strenuously denied. Their presence is now not open to doubt, the very research which I have quoted—that of Fühner and Starling—affords ample proof of it, and evidence no less convincing was brought forward by Mrs. Tribe from the very laboratory from which the original denial of vasomotor nerves in the lung came [6].



2660 c.c. per min. 5260

Slide 20.—Tracings of respiratory rhythm and normal right intraventricular pressure. R., respiration. P., pulse. Vertical scale, pressure in centimetres of water. S., mean systolic, and D, mean diastolic pressures expressed in mm. of Hg. Time, seconds.

It would seem then that the pulmonary circulation closely resembles the systemic, that just as the pressure in the systemic arterial system is controlled by the depresser nerve, so also there must be a similar reflex from the right heart which controls the calibre of the vessels in the lung and so maintains a fairly constant pressure in the pulmonary artery. Some evidence of the path of this reflex mechanism has been furnished by Schafer [7]. It is being pursued further in the Cambridge Laboratory at the present.

Part III.

In Part I of my lecture I have shown that the capillary bed of the hepatized portions of lung is closed; in Part II that the regulation of the size of the vessels in the lung is under nervous control.

In the few minutes which remain I should like you to fit these two propositions together. What mechanism is responsible for the closure of the capillaries in the hepatized portions of the lung?

Four possibilities suggest themselves :—

(1) Thrombosis of a fibrinous nature.

(2) Congestion and thrombosis with red corpuscles.

(3) Vaso-constriction.

(4) Pressure of œdematous fluid on the capillary walls.

One or other of the two forms of thrombosis—white or red—are found in a certain proportion of the vessels; but these are the minority. Although therefore thrombosis and increased friction were very attractive possibilities by which to account for the deficient circulation in the case of an inflamed organ, they had to be regarded as subsidiary, for the simple reason that the histological findings were against them, though many capillaries were engorged with corpuscles which filled up the cavities of the vessels and which could be washed out by post-mortem irrigation.

But in the œdematous area the great majority of the closed capillaries are filled neither with fibrin nor with a plug of corpuscles. I said that an impressionist view of the vessels in slide 4 showed them to be uninjected. I used the word impressionist advisedly. A careful inspection of the slide shows that many of the vessels which appear uninjected at first sight really contain threads and dots of gelatine down their whole length—threads and dots much smaller in diameter than a red corpuscle, but large enough to show that the capillaries are still patent though collapsed. They are closed yet capable of opening, a condition incompatible with thrombosis but entirely compatible with explanations 3 and 4 above, namely that:—

(i) The area is shut off by vasomotor influences.

(ii) That the capillaries are compressed by the œdema fluid in alveoli. The latter explanation was the one which we adopted and which, in the absence of definite information to the contrary, we would probably still adopt, but in view of the experiments by Dale [8] and by Krogh [9] on the change of calibre capillaries it is possible that our view may need revision.

So much then for the mechanism of the closure of the capillaries in the œdematous parts of the lung described in Part I. Whichever alternative you adopt, apply to it the facts which we have discovered in Part II in answer to the following question.

When the gassed animal takes exercise what will happen to its pulmonary circulation? *Let us first assume that the animal's vasomotor system reacts normally.* The answer will be as follows:—

(1) The pulmonary vessels will dilate.

(2) This dilatation may be confined solely to the unœdematous area or

(3) It may spread to the œdematous area.

If this dilatation spreads to the œdematous area blood will circulate through this area on whichever of the theories of closure you adopt. On the vasomotor theory it will do so as a matter of course. On the alveolar œdema theory it will do so because the capillary pressure will rise to above its former level and therefore to above the pressure at which the œdema fluid was secreted.

And now as to the bearing of this change in the circulation on the aeration of the blood. To take the oxygen only:—

Consider both the œdematous and the unœdematous areas. By the opening up of the œdematous area you at once permit blood to pass through the lung which does not become oxygenated on the way. By allowing it to rush at an inordinate speed through the unœdematous but recently gassed lung, you achieve

the same end; for the epithelium of this portion has thickened in many places and therefore the oxygen may not be able to get through the alveolar wall with sufficient speed to fully oxygenate the blood. In either alternative therefore you stand to get blacker blood in the pulmonary vein than normal, and that is what in fact you do get.

I have seen it in a rabbit which was gassed the day previously. The rabbit was lying on the dissecting table under an anæsthetic; its blood in the carotid artery was quite red. It gave some sudden muscular movements, as the result of which the arterial blood at once darkened in colour. Such a darkening does not take place in an ungassed rabbit.

The following figures give a quantitative idea of the fall in the saturation of arterial blood with oxygen in the gassed rabbit:—

PERCENTAGE SATURATION OF ARTERIAL BLOOD WITH OXYGEN.

Experimental number of rabbit	Condition	Rest	During muscular contraction	Immediately after exercise	20 minutes after exercise
19	Ungassed	94	96	—	93
20	,,	94	—	95	—
21	*Gassed 16 hours	93	83	80	84
22	,, ,, ,,	93	87	87	92

* Dose, phosgene 1/60,000 for 30 minutes.

Similar to the above has been the experience in goats, though it has been arrived at in a different way. The rabbits quoted above were anæsthetized with hemol or urethane, and the muscular contractions were induced by touching the rabbits with electrodes. In the case of the goats, the exercise was of quite a normal character. In some instances it was imposed upon the goat by chasing him in the paddock or on the road; in others, the goat initiated it of his own free will by resenting being handled. But in either case it was sufficient to cause a large increase in the quantity of oxygen which the goat was absorbing at the time.

The following are examples:—

Goat	Hours after gassing	Level of oxygen saturation in blood (resting)	Oxygen saturation during exercise	Depression
2,181	24	87 %	81 %	6 %
2,403	10	81	44	37
2,380	40	92	87	5
2,952	45	90	67	23

In some of the above cases the depression is not very great; but the fall in saturation of the arterial blood with oxygen is never so small that we can afford to neglect it. Being unable to neglect it, we must therefore see what explanation can be given.

We need invoke no factors which are not already at hand.

There are two possible explanations, which, however, are in no way mutually exclusive.

(1) The first is that the excessive quantity of oxygen which the body demands during exercise cannot pass through the functionally thickened wall of the gassed lung.

(2) The second is that, in order to relieve the right heart, the functionless, or relatively functionless, capillary areas open up, and blood passes, which therefore has not proper access to oxygen. Some further examination of these two causes is desirable.

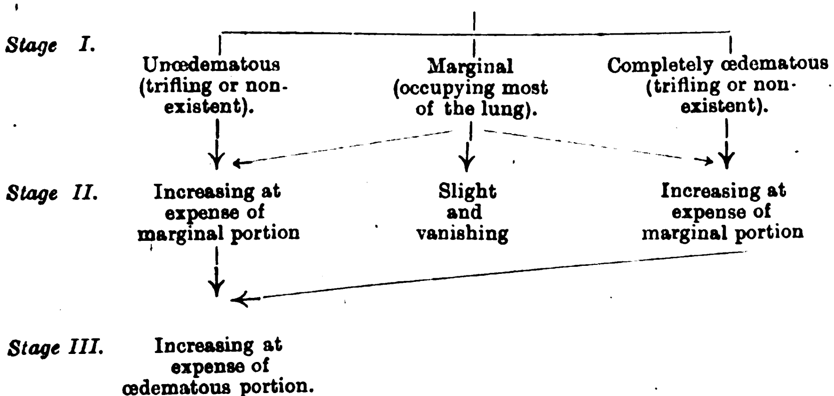
What evidence is there of functional thickening of the alveolar wall? It may be of two characters.

(1) The formation of a film of œdematous fluid over the surface. In this connexion, remember how delicate the normal epithelium of the lung is. The cells are almost immeasurably thin, therefore quite a trifling film of œdematous substance, such as one sees in many sections, would increase manyfold the thickness of the barrier which separates the alveolar air from the blood. This filminess on the wall is, on the whole, an early feature. In the later stages of gas poisoning, such thickening of the wall as takes place is due to thickening of the epithelium, a condition which seems to be insufficient to account for the darkening of the general blood supply.

(2) The possible causes of opening up of the capillary areas have already been discussed.

Reviewing the facts which have been put forward, the following scheme may be put forward as summarizing them. This scheme gives an idea on the one hand of the general course of gas poisoning as shown by post-mortem, and on the other of what effect the observed changes are likely to have on the oxygenation of the blood should the arterioles which supply them dilate.

Gassed Lung divided into areas as follows:—



Unœdematous portion:	Marginal portion:	Completely œdematous portion:
Stage I. Calibre of vessels uncertain	Calibre of vessels uncertain	—
Stage II. Vessels partially dilated to compensate for closure elsewhere, to that extent less capable of further dilatation	,, ,, ,,	Vessels closed
Effect of exercise: Such further dilatation as possible; oxygenation good where epithelium normal.	Increased blood flow; oxygenation deficient where epithelium is coated	Increased blood flow; oxygenation very deficient

The above scheme assumes the least degree of damage, namely damage to the lung but no damage to the central nervous system, i.e., no change in the vasomotor response.

If the damage be greater and the nervous system be involved, the dilatation which is part of the normal mechanism for the maintenance of the body's stability will be impaired, the pressure in the pulmonary artery will rise during exercise and a back pressure will be set up in the veins, the body will act more like a machine.

In the stationary hospital there was a case of gas poisoning which was very much to the point. Pte. G., seen by me on May 9, 1915, gassed four days previously presumably with chlorine. As seen in bed there was but slight cyanosis. On effort or even the suggestion of effort his face at once took on a blue colour. You cannot exactly say that his face flushed because the colour was wrong; but if my reading of the case is correct you can say that his lung flushed: and in flushing it passed increased quantities of blood without adequately oxygenating the hæmoglobin. At all events his face presented just the appearance which one might expect on the assumption of vascular dilatation in the unaerated areas.

So ends what I have to say about pathology. The moral, as regards gas poisoning is, that to the capillaries in the lung are given the keys of life and of death, or some of them at all events. What Nature has closed let not man open. If Nature would cut down the activities of the patient to such as can be served by a limited quantity of good lung, let not the patient defeat his guardian angel by insisting upon exertion. For if he does one or both of two things will happen.

The least grave alternative is that the circulation in the lung will open up and black blood will pass.

The more grave condition is that the circulation in the injured lung will not open and that insufficient blood will pass.

In either case you stand to get an inadequate supply of oxygen to meet the increasing demand of the more active man—in that latter case you have superadded the possibility of back pressure starting in the pulmonary artery and overloading the heart. Then the first condition of treatment of poisoning with pulmonary irritants must be absence of exertion, or in other words REST and WARMTH. To this often more specific treatment such as oxygen may be added as indicated.

So much then as regards gas poisoning. I would say a few further words. Do you still think that I have been discussing something very narrow, a mere aspect of a clinical condition which possibly—nay probably—you may never see? If so, think again. Does what I have told you apply only to broncho-pneumonia caused by phosgene or chorpicrin? Does it not play a part in broncho-pneumonia from any other cause? In an infective condition you have to deal with the toxin as well as the lesion. While we have learned nothing about the toxin we have learned much about the lesion. We have learned some principles which may apply to lesions far removed from the lungs. And we have learned something beyond the study of lesions, something of the difference between the less mechanical normal and the more mechanical pathological, something as wide as pathology itself.

I should like to take this opportunity of expressing my thanks to those who worked with me at Porton, for to them I owe most of the facts discussed above: to Majors Boycott, Peters, and Dunn of the Royal Army Medical Corps, to

Lieutenant-Colonel Crossley, C.M.G., for the constant facilities which he afforded to physiological work in an organization which was primarily chemical, to Lieutenant-Colonel Douglas, C.M.G., Colonel Elliott, C.B.E., and especially to Colonel Cummins, C.M.G., and Colonel Sir William Horrocks, K.C.M.G., C.B., for the help given by the Army to an enterprise of the Ministry of Munitions.

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Report.

REPORT OF A COMMITTEE OF INQUIRY REGARDING THE PREVALENCE OF PELLAGRA AMONG TURKISH PRISONERS OF WAR.

(*Continued from p.* 79.)

APPENDIX V.

PROTOZOOLOGICAL AND OTHER PARASITOLOGICAL INVESTIGATIONS ON PELLAGRA.

The following work has been done by me as protozoologist to the Committee, since October 16, 1918:—

Scope of Investigation.

My investigations have fallen mainly within the scope of Section (A), subsection (B) of the terms of reference:—

"To investigate the ætiology of the disease in relation to protozoa."

A number of hæmatological observations were also made, which fall under subsection (C), "Blood conditions."

My primary aim, therefore, has been to ascertain whether any evidence was to be found, from a study of cases of pellagra, which would incriminate some protozoan parasite, known or hitherto unknown, as a causal factor in this disease. In addition, a record has been kept of the occurrence of all other animal parasites, in view of the possibility of such infection having a bearing upon the incidence of the disease.

Plan of Work.

The investigation was commenced by a thorough examination of the *blood* of cases of pellagra in all stages, from very early to advanced. The blood was studied both fresh, by means of stained films, and also with the aid of dark-ground

illumination; the last method being with a view to the possible discovery of any "ultra-microscopic" causal organism.

Considerable attention was paid to the cell constitution of the blood itself, and differential counts were made in a large proportion of the cases. A comparison has been made with the blood counts of prisoners in the Kantara Labour Camp, who were regarded as free from pellagra.

The *cerebrospinal* fluid and urine of these selected cases, early and advanced, were then examined by the above methods.

Finally, a comprehensive study of the *intestinal fauna* of a large number of pellagrous cases has been undertaken, and the findings obtained have been compared with those observed both amongst non-pellagrous Turkish prisoners and amongst German prisoners.

As pellagra is, admittedly, the expression of some general condition, it was considered that the above series of examinations would amply cover the necessary ground, if a protozoan cause for the disease was to be demonstrated.

Results of Examinations.

(*A.*)—Blood.

The blood of eighty cases of pellagra, including all stages of the disease, was exhaustively examined for any possible form of organism. Of these cases, 15 (i.e., 16·6 per cent) were malarial, parasites being found in 11 cases, and the blood picture of the other 4 being that of chronic malaria. Apart from malarial parasites, no other kind of parasite—no "cryptic" hæmatozoan—was detected.

No leucopenia was present in the non-malarial cases, the leucocytes being normal, or, if anything, very slightly above normal in number. A polymorphonuclear leucocytosis occurred only in a single case. Of the 65 non-malarial cases, only in 3 was there a slight increase in the large mononuclear count, ranging from 7 to 9·8 per cent. In 62 (i.e., 95 per cent) the count varied from 1·5 to 6 per cent, the average being 4 to 5 per cent, i.e., normal.

A noticeable variation from the normal differential count was an increase met with in several cases in the lymphocytes. This count usually ranged between 27 and 32 per cent, the average being 30 to 31 per cent, but in 10 cases (i.e., over 15 per cent) the total lymphocyte count was distinctly high, above 35 per cent, 4 of these showing over 46 per cent of lymphocytes. This lymphocytosis occurred amongst early cases as well as advanced. But the blood of 15 prisoners regarded as non-pellagrous was also examined, and 4 of these (i.e., 26 per cent) also showed a lymphocyte count of over 35 per cent, 1 having a lymphocytosis of 52 per cent.

A definite lymphocytosis in pellagra has been previously noted as the chief feature in the differential count. Although in the cases I examined the occurrence of this condition was more variable than was found by other workers, it may be concluded, I think, that some degree of lymphocytosis is frequently associated with pellagra. As regards the four normal cases at Kantara, in which some lymphocytosis was also found, although these were non-pellagrous when examined, judging from the extent of the outbreak they might at any time have begun to develop pellagrous symptoms.

Eosinophilia, ranging from over five per cent up to fifteen per cent, was

frequently found, but this had no constant relation to the observed occurrence of nematode eggs in the stool. On many occasions, eosinophilia was present when no eggs were found; in such cases a prior or actually existing infection with worms was regarded, however, as extremely likely. On the other hand, in some cases where, from an examination of the stool, *Ascaris* or *Trichocephalus* was ascertained to be present (even numerous) no eosinophilia was found; the eosinophiles numbering from 1·5 to 4 per cent only. Such cases had probably been infected for a considerable period, and lost an early eosinophilia. The absence of eosinophilia, therefore, is no proof of the absence of these nematodes; on the contrary, such a case may have a heavy helminthic infection.

(*B*)—Cerebrospinal Fluid.

The cerebrospinal fluid of eleven cases (specially selected by Colonel Boyd, and drawn off by him) proved to be quite normal.

(*C*)—Urines.

The examination of the urines of these same cases also yielded entirely negative results.

(*D*)—Stools.

A total of 222 stools of pellagrous cases have been examined, 121 at No. 2 Prisoners of War Hospital, Abbassia, and 101 at No. 5 Prisoners of War Hospital, Kantara. The former were non-labour and the latter labour prisoners.

Of the 121 at Abbassia, 16 (13·2 per cent) had bacillary dysentery, and 8 (6·6 per cent) had amœbic dysentery (active). Altogether nearly twenty per cent were dysenteric, therefore, in addition to being pellagrous. Of the remaining ninety-seven, the majority of which were cases of well-marked or also advanced pellagra, at least half were diarrhœal, the stools being thin, often frothy, with undigested vegetable residue and with generally an offensive odour.

On the other hand, the stools of the 101 cases at Kantara were, on the whole, much more normal in appearance. Most of these cases were just commencing, or early. Bacillary dysentery was present in seven per cent of these cases, amœbic dysentery in only one per cent. Only nine per cent of the remainder were diarrhœal, with the unhealthy characters just noted. In contrast to the small number showing active amœbic dysentery, eight were "carriers" of the cysts of *E. histolytica*, i.e., the proportion showing the active and quiescent stages of this parasite was about reversed in the Abbassia and Kantara cases, respectively.

The harmless *E. coli* occurred frequently, viz., in about twenty-seven per cent of cases.

The flagellate *Trichomonas intestinalis* occurred in 31 of the Abbassia cases (i.e., in 25 per cent), but was found in only 5 per cent of the Kantara ones—an important difference.

The peculiar parasite, *Blastocystis*, was of frequent occurrence in the Abbassia cases, and often very abundant. The frothy, gaseous character of many of the diarrhœal stools was probably partly due to this organism.

The animal parasites which were by far the most predominant were nematode worms of the genera *Ascaris* and *Trichocephalus*. The actual percentage findings of the eggs were: *Ascaris*, 31·5 per cent, and *Trichocephalus*, 21·6 per cent.

These figures by no means indicate the real proportion of Turkish prisoners infected, which I estimate to have been certainly twice as high, and probably more. In one batch, for instance, of 31 cases amongst prisoners recently

captured, with serial registration numbers close together, 24 (or over 77 per cent) were actually found to be infected with *Ascaris*. Individual infections were usually heavy, not the slightest difficulty being experienced in finding the eggs; but where the eggs happen to be very scanty in a particular stool, they often escape detection by a single examination. In a few cases where the stool of the same case had been accidentally sent in for examination again, eggs were found at the second examination when the first had proved negative. Further, the occurrence of definite eosinophilia (noted above) in cases where eggs had not been found at the time the stool was examined also points nevertheless to the presence of one or both of these worms.

It is important to note, however, that the percentage of similar helminthic infections amongst the non-pellagrous Turkish prisoners was found to be equally high. In addition, the stools of German prisoners (who do not develop pellagra) were examined. These were also found to be infected to a considerable extent with the same worms, although in a less degree than were the Turks, *Ascaris* being found in 15 per cent of the stools examined.

It is noteworthy that in not a single case was the occurrence of *Ankylostomum* eggs or of *Bilharzia* eggs observed.

No new parasite of any description was found in any of the stools, which were all thoroughly examined.

Details of all the findings, both actual numbers and percentages, in pellagrous and in non-pellagrous cases are given in the accompanying Table I.

TABLE I.

	Pellagrous			Non-pellagrous			German (normals)
	Abbassia	Kantara	Total	Abbassia	Kantara	Total	
Examinations	121	101	222	72	23	94	47
Bacillary dysentery ..	16	7	23	12	1	13	1
	13·27%	7%	10·4%	16·6%	4·5%	18·3%	2·1%
(*a*) Amœbic dysentery	8	1	9	3	0	4	0
(active histolytica)	6·6%	1%	4·1%	4·2%	0	3·2%	0
(*b*) Histolytica cyst	2	9	11	5	4	9	5
"carriers"	1·7%	9%	5%	7%	18·1%	9·6%	10·6%
Other protozoa—							
Trichomonas	31	5	36	9	1	10	5
	25·6%	5%	16·2%	12·5%	4·5%	10·6%	10·6%
Lamblia	13	10	23	7	1	8	1
	10·8%	10%	10·4%	9·7%	4·5%	8·5%	2·1%
Macrostoma	5	3	8	1	0	1	1
(Syn. tetramitus)	4%	3%	3·6%	1·3%	0	1%	2·1%
E. coli	28	32	60	20	8	28	17
	23·1%	32%	27%	27·7%	36·5%	29·8%	36·1%
Helminthia (Nematodes)—							
Ascaris	52	18	70	32	3	35	7
	43%	18%	81·5%	44·4%	13·6%	37·2%	15%
Trichocephalus	28	20	48	11	3	14	4
	23·1%	20%	21·6%	15·3%	13·6%	14·9%	8·5%
Trichostrongylus (Cestodes)	1	1	2	0	0	0	0
	0·8%	1%	0·9%	0	0	0	0
Tænia	1	1	2	0	0	0	1
	0·8%	1%	0·9%	0	0	0	2·1%
Hymenolepis	3	2	5	0	0	0	2
	2·5%	2%	2·4%	0	0	0	4·2%

Summary and Conclusions.

The above results show that there is not the slightest evidence of a protozoan parasite having any specific ætiological relation to pellagra.

As regards the blood, not only has no parasite been found, but a hæmatological feature is that no increase of large mononuclears is associated with the disease. (The very small proportion, viz., five per cent, of non-malarial cases showing a slight increase can be neglected; this may quite well have been due to a precedent attack of relapsing fever.) The absence of any large mononuclear increase is, of itself, weighty evidence against a protozoan cause.

With regard to the intestinal protozoan parasites, the most harmful of them, namely *E. histolytica*, occurred in far too small a proportion of cases (nine per cent), for it to have any special significance in connexion with pellagra. *Trichomonas*, which occurred fairly frequently in pellagrous cases, particularly in those with diarrhœa, was probably partly responsible for this intestinal disturbance. Amongst the early cases at Kantara this parasite was seldom present, and the stools were much more normal in character. There is no reason to suppose that this or any other intestinal flagellate has any causal relation with pellagra.

No spirochætes of any kind were detected, either in the blood, cerebrospinal fluid, or urine.

With regard to the possible occurrence of some "ultra-microscopic" organisms, all that can be said is that as a result of careful observation with dark-ground illumination, I could find nothing abnormal or unusual. So far as this result goes, it leaves the question of existence of such an infective agent still open because, whether a specific ultra-microscopic organism or a non-living virus were concerned, it is obvious from the examples of the exanthemata, yellow fever, etc., that years of research might be necessary for its discovery.

From the observations detailed above, it is evident that the presence of nematodes (especially *Ascaris*) was very general amongst the Turkish prisoners of war; not only amongst the pellagrins, but equally amongst those who were liable at any time to become pellagrous. These were, in fact, the only animal parasites found which, on account of their general prevalence, might be held to have some ætiological significance in connexion with pellagra. And this possibility is one, I think, which deserves consideration. There is of course no intention of suggesting here that helminthic infections, by themselves alone, constitute the specific cause of pellagra. In the course of the present work, for instance, I found that German prisoners, none of whom have developed pellagra, were also frequently infected with the same worms (see Table I) and such infections are known to be prevalent in many districts and countries where pellagra never, or only rarely, occurs.

The view I wish to put forward is that such helminthic infections are to be regarded as an additional or contributory factor in the ætiology of the disease, perhaps especially important as a predisposing cause. I am unable to discuss this question here, as reference to other work or a consideration of epidemiological data in this connexion would exceed the scope of this report.

Conclusions.

(1) That pellagra is not due to any protozoan cause.

(2) That no evidence has been obtained tending to incriminate any other minute organism, either a spirochæte or an ultra-microscopic form of parasite.

(3) That as regards the blood-condition, the only noticeable feature is a certain degree of lymphocytosis frequently found in association with the disease.

(4) That importance is to be attached to the occurrence of helminthic infections as constituting a possible factor in the ætiology of the disease.

(*Signed*) H. M. Woodcock.

APPENDIX VII.

Statistical Data.

In addition to the work of this section already dealt with in the body of the report, certain details of the methods adopted and accessory findings remain for discussion here.

A.—Compilation of Information.

The Committee found much valuable information in the careful records maintained by Lieutenant-Colonel P. S. Vickerman at No. 2 Prisoner of War Hospital, where all prisoners of war sick and wounded had been accommodated prior to the final rout of the Turks making it necessasy for other hospitals to share the work of dealing with the large increase of prisoners and their patients. These records had already been analysed by Captain H. E. Roaf, to embody the available information regarding pellagra incidence from the date of the recognition of the first case among prisoners of war in November, 1916.

The following information was obtained—the first returns being made retrospective in order to connect up with Lieutenant-Colonel Vickerman's records, and enable *per mille* ratios to be worked out:—

(*a*) The weekly ration strengths of all prisoners of war camps were rendered by their commandants. These were retrospective from Jan. 1st, 1918, and provided the basis for calculation of *per mille* ratios.

(*b*) The totals of prisoners by months from September, 1916, were obtained from the Central Statistical Bureau, Prisoners of War.

(*c*) Hospital admissions and deaths from pellagra, by *pro forma.*

"Pro Forma." Hospital Return.

Admissions and Deaths from Pellagra among Prisoners of War (for previous twenty-four hours).

Gen. No.	Camp from which admitted	Date of capture	Date of admission to hospital	Date of death	Any contributory cause of death	Camp, if any, at which he had been employed as labourer	Remarks	Nationality

From the above returns the charts were made up week by week, after an interval to ensure all hospital admissions being recorded by the correct camps, and after checking all patients' general numbers to preclude all the duplication of entries for individual cases transferred from one hospital to another.

In addition to charts and graphs Nos. 1 to 4, a graph was commenced to show the number of months that patients had been in captivity, but this was abandoned on its becoming apparent that it was dominated by the fact of the great majority of prisoners having been captured in two large batches in the autumns of 1917 and 1918.

(*d*) Endemicity data obtained by captured Turkish Medical Officers at Kantara and at Cairo (Drs. Hakimian, Kalfyan and Anastassiades), with a view to ascertaining whether pellagra is endemic in Asia Minor; if, and when, it increased among the Turkish troops; and if the domicile and occupations of enemy troops before enlistment were such as to bear upon their subsequently becoming pellagrous.

"Pro Forma." Endemicity Return.

Gen. No.	Unit	Div.	Domicile		Occupation	If any similar case in family	Date of capture	Date of joining Turkish Army	Date and place of onset of the first symptoms of pellagra
			Vil-layet	Urban or rural					

From this return, a map was prepared to show the villayets whence the pellagrous prisoners were recruited and the districts in which they were when they first noticed the pellagra symptoms from which they were suffering when questioned.

B.—Findings accessory to those dealt with in this Report.

(*a*) Chart 1.

The abrupt rise and high figures in the summer months of 1918 are probably mainly artificial: the pellagra cases assembling at Kantara during May and June were not diagnosed until June 27th, when a large number were sent to hospital in the course of the next few days, thus giving high figures for both June and July, which should have been distributed over those months and May—or possibly April also. There ensued so thorough a weeding-out of all even suspicious cases as to have antedated many admissions that otherwise would probably not have occurred until September, which consequently shows a low figure.

The fifty per cent fall in the final month is very significant.

(*b*) Chart 2.

The mortality curve closely follows that of the hospital admissions, and at a uniform interval of about a month, varying from twenty per cent to fifty per cent of the latter. As shown in the pathological section, the mortality directly due to pellagra has been insignificant, but debilitated pellagrins are liable to recurrent

attacks of dysentery or malaria or to secondary influenzal pneumonia from which they rapidly succumb, the average period in hospital of those progressing to fatal termination appearing to be three or four weeks.

(*c*) Graphs 3 and 4.

Call for no further comment save that they show a satisfactory fall in pellagra incidence during December, especially for labour prisoners.

(*d*) Chart 6.

Indicates no correspondence between variations in the dietetic and pellagra incidence curves for the periods charted.

Many thousand calculations were involved in the working out of its weekly averages from the records of actual issues made.

(*e*) Graphs 7 and 8.

Are left for detailed discussion in a later appendix, but it is noted that unique opportunities were afforded this Committee for the collection of precise data as embodied in these graphs and in Chart 6.

(*f*) Map.

(*i*) *Domicile.*

Not one of the 518 pellagrous prisoners questioned by their own M.O.s. dated the initial onset of his symptoms to a period prior to enlistment, and only five had seen similar symptoms in members of their family or neighbours. This confirms the opinion of so many Turkish M.O.s. that pellagra is endemic to a very slight extent, if at all, in Asia Minor.

It also indicates that this disease broke out as a result of conditions to which the Turkish troops were subject while on active service, and especially when their privations were more acute at a late stage of operations. In this connexion attention is drawn to the fact that four, and only four, men first noticed their symptoms in Gallipoli.

(*ii*) *District in which initial Pellagrous Symptoms occurred.*

The first point to be considered is whether pellagra is endemic in areas where pellagrous symptoms were first noticed by those affected. Many Syrian doctors serving with the Turks stated that this disease was almost unknown in Syria before the war, although they were familiar with its symptomatology. One of them had seen only five cases during thirteen years' practice in Damascus and district.

The numbers are seen to be most aggregated in precisely those districts where the Turks were most concentrated when suffering maximum privations, but where prisoners were never retained for more than the few days necessary before they could be sent down the L. of C. towards the base. Over eighty-five per cent of the 474 men questioned stated that their (pellagrous) symptoms had appeared before capture.

(*g*) Further Information derived from the "Endemicity Return."

(*i*) *Character of Domicile and Occupation.*

Domicile	
Given as—	
Urban	119
Rural	463
	582

Occupation.	
Agriculturists	265
Labourers	73
Artisans	33
Shopkeepers	8
Sailors	8
Coachmen	7
Shoemakers	7
Bakers	6
Butchers	6
Store-keepers	6
Carpenters	5
Chauffeurs	5
Schoolmasters	5
Of nineteen other trades ..	33
	467

From this table it is obvious that the majority of these prisoners were drawn from that part of the community regarded as most liable to pellagra—agriculturists living in rural areas. They may have been predisposed, but the above evidence is wholly against their having been pellagrous prior to enlistment. The essential parallel of the proportions of men of the above occupations and domiciles in the whole Turkish army is not available.

(*ii*) *Relation between Dates of Capture and of Initial Symptoms.*

The following table is derived from questioning equal numbers of fresh captures at Kantara and old prisoners at Heliopolis.

	Months	Cases			
Onset before capture ..	Over 12	26			
	12	5	40	345	414
	11	24			
	10	4			
	9	3			
	8	2			
	7	2			
	6	71	279		
	5	48			
	4	22			
	3	30			
	2	26			
	1	39			
	0	43			
Onset after capture ..	0	10	27	69	
	1	0			
	2	3			
	3	0			
	4	0			
	5	3			
	6	11			
	7	2	13		
	8	4			
	9	0			
	10	2			
	11	1			
	12	4			
	Over 12	29			

This table is sufficiently striking to make comment superfluous.

(iii) *Distribution of Cases among the Turkish Forces.*

Division	Cases	Division	Cases	Corps Troops	Cases
11th	53	26th	14	7th	20
19th	42	48th	11	4th	9
16th	40	54th	9	8th	9
3rd	40	25th	9	20th	6
7th	35	42nd	8	22nd	5
1st	29	47th	6	3rd	3
53rd	27	8th	5		
24th	22	—			
20th	21	3rd Cavalry	8		
46th	20	33 others	54	No information known	86

This table indicates the wide distribution of pellagra cases among no less than . Divisions and 6 Corps having representatives with the Turkish forces.

It is obvious that some generally applicable ætiological factor must have been involved, rather than special conditions due to location, and force is added to this deduction by the fact that no case of pellagra is known to have occurred amongst the British and Indian troops who have since occupied the areas in which onset of pellagrous symptoms occurred in so great a majority of the pellagrins among these Turkish prisoners.

(*h*) All Officer, and German other Rank Prisoners,

were respectively, relatively and wholly immune (*vide* body of the Report).

Conclusions.

These are so many, and so obvious, that only those with special bearing upon the terms of reference to the Committee call for mention here.

(1) That the great majority of prisoners of war pellagrins were pellagrous before capture.

(2) That they became so in Syria and Palestine during this war, and as a result of conditions affecting Ottoman rank-and-file of all formations, but affecting officers little and Germans not at all.

(3) That the disease is now not increasing, but is decreasing.

(4) That the disease is not due to case-to-case infection nor to any local conditions (*vide* data discussed in the body of this Report).

(*Signed*) P. S. Lelean,

December 30, 1918. *Lieutenant-Colonel, R.A.M.C.*

APPENDIX VIII.

DIETETIC REPORT.

With an Analysis of Food Materials, a Comparison of Ration Scales, and the Results of Metabolism Experiments undertaken to determine the Degree of Absorption of Food.

This Report embodies the results of an analytical investigation of the feeding of all prisoners of war.

(*a*) Analytical Work.

This was carried out in the Physiological Laboratory of the Kasr el Aini Medical school.

(1) *Analysis of Foodstuffs.*

Various samples taken in supply depots and camps were analysed to determine if the foodstuffs employed contained the amount of proximate principles upon which the nutritive value of the rations have been calculated.

Date	Camp	Material	Defects noted	Percentage: Protein N. × 6·25	Fat	Carbohyd. (by diff'ce)
Oct. 10, 1918	Kantara	Bread ..	Defective aeration ..	7·1	1·2	54
,, 23 ,,	Heliopolis	,, ..	,, ,, ..	6·5	—	—
,, 23 ,,	Kantara	,, ..	,, ,, ..	6·6	1·2	49
,, 23 ,,	Heliopolis	Millet flour	Weevily and rancid ..	15·6	—	—
,, 23 ,,	,,	Wheat flour	*Nil*	9·7	—	—
,, 23 ,,	,,	,, ,,	,, ...	9·3	—	—
Nov. — ,,	Kantara	Millet flour	,, ...	15·3	—	—
,, — ,,	,,	Wheat flour	,, ...	9·6	—	—
,, — ,,	,,	,, ,,	,, ...	9·8	—	—
Oct. 10 ,,	,,	Camel meat	No visible fat ..	20·1	2·5	—
,, 23 ,,	Heliopolis	,, ,,	*Nil*	15·5	6·7	—
Nov. — ,,	Kantara	,, ,,	(average of six samples)	19·65	—	—
Oct. 10 ,,	,,	Lentils ..	*Nil*	29·3	—	—
,, 10 ,,	,,	Beans ..	,, ...	26·8	—	—
,, 23 ,,	Heliopolis	,, ..	,, ...	26·8	—	—
,, 10 ,,	Kantara	Rice ..	,, ...	7·8	—	—
,, 23 ,,	Heliopolis	,, ..	,, ...	7·8	—	—
,, 23 ,,	,,	Cheese (skim milk)	,, ...	19·8	—	—

(2) *Analyses of individual Day's Rations at E. Kantara Labour Camp, November* 18, 1918.

These analyses were made to ascertain whether the actual amounts of food received by individual prisoners corresponded with those laid down in ration scales.

In practice, however, it proved só difficult to obtain reliable samples for this purpose—owing to the series of unweighed distributions occurring between issue from the Q.M. stores and sampling from individual degchies—that the Committee decided to adopt the figures obtained from supply depots, as checked on two occasions by one of us (P.S.L.) comparing the depot records of issues against the actual day's receipts at E. Kantara and Heliopolis camps.

(*a*) Stew.

Five bulked, repeatedly minced, and thoroughly mixed rations of stew—consisting of meat, rice, beans, and onions—gave the following average weight in grammes per ration.

	Protein		Fat
Protein (nitrogen × 6·25)	42		
Fat	—	..	31·6

(*b*) Residue of ration.

	Protein		Fat
Protein (analysis of 1 ration of 2 sample loaves) ..	57	..	—
Fat	—	..	10·8
Totals for one day's rations, grammes ..	99		42·4

Conclusions.

(1) That in general the foodstuffs employed contained the normal amounts of proximate principles upon which the nutritive value of the rations has been calculated.

(2) That the bread contains the ordinary amount of protein in bread made from local cereals, but, owing to defects in baking, the protein is probably not available to a normal extent.

(3) The camel meat (unless very lean) contains less protein than beef, upon which the estimations have been made.

(*To be continued.*)

Reviews.

INJURIES TO THE HEAD AND NECK. By H. Lawson Whale, M.D.Camb., F.R.C.S.Eng. With preface by Colonel Frederick F. Burghard, C.B , M.D., M.S., F.R.C.S. London: Baillière, Tindall and Cox. 1919. Pp. ix and 322. Price 15s. net.

The author in his introduction defends his choice of the title, "Injuries of the head and neck." A careful perusal of the book shows that injuries of the most important part of the head, i.e., the brain, are practically not mentioned, and no indication is given by the title that the book is inspired by and mainly deals with war wounds of the face and neck.

This is unfortunate as one might readily choose this book as a treatise on the head, and serious disappointment would result.

"Gunshot Injuries of the Face and Neck" would have more accurately described the contents.

Chapter I deals with Hæmorrhage, and those who have had any experience in dealing with gunshot fractures of the jaws will recognize that this, by far the most serious and fatal complication of wounds in this region, occupies its right position in the book.

The subject is fully dealt with and the difficulties of establishing, in many cases, the side from which the bleeding is coming, is strongly emphasized. The author has been fortunate in that he has never seen any central effect after ligature of the common carotid. In our experience some change could always be noted, in some cases marked paresis which was later recovered from.

Transfusion of blood is rather inadequately dealt with and we would have been glad of a fuller description of the author's method of using paraffined syringes, as in the hands of most surgeons syringes treated with paraffin have been found quite unworkable.

The difficulties encountered in attempting to remove foreign bodies from the face and neck are well described.

In dealing with infection in the neck the author quite rightly emphasizes the great importance and extremely fatal consequences of mediastinitis. His description of the signs and symptoms of this complication is most interesting.

In the chapter on the Pharynx and Œsophagus the author includes buccal and salivary fistulæ. This does not strike one as anatomically correct, but he deals with the subject so briefly that a separate chapter was hardly justified.

Wounds of the Œsophagus are shortly dealt with and the danger pointed out. We think the gravity of this injury might have been even more forciby put. We have only once seen a patient recover who was suffering from a gunshot wound of the œsophagus which leaked into the neck.

Chapters IV to VII deal with the Larynx, the Ear, the Nose and Accessory Sinuses.

Here, the author, dealing with his own special subject, gives a lucid and interesting account of the treatment of gunshot injuries of these regions in which many new points are brought out.

Chapters VIII to XII are devoted to plastic work such as Rhinoplasty and repair of the face.

It is a well known fact that the soldier dreads a serious disfigurement of his face more than the loss of a limb, and these chapters show what marvellous strides have been made during the war in the direction of plastic work.

The illustrations of this part of the book are excellent reproductions of Major Valadier's photographs, and show clearly the wonderful results that can be attained by patient and well planned plastic operations.

The descriptions of the various operative steps are good, but in our opinion the text would have been made clearer by a few diagrams. The excellent photographs do not illustrate all the steps of the operations.

From Chapter XIII to the end of the book is devoted to injuries of the jaws.

The author had much experience of this class of injury at 83 General Hospital in France and in association with Major Valadier excellent results were obtained.

The account of these injuries would have been improved by a more detailed description of the methods of dental splinting with some indication as to how far this ought to be attempted in the forward areas.

For instance, no mention is made of the reconstructed models which are necessary in making a splint for a fracture of the mandible with displacement of fragments.

The greater part of this section of the book is devoted to bone grafting, about which the author is apparently very optimistic.

It is a well recognized fact that the worst disaster that can happen to a man with a fractured mandible is non-union, and rather than risk this it is often advisable to allow some displacement of fragments to occur so as to secure approximation of the fractured ends and so secure bony union at the expense of some loss in articulation of the teeth. No mention is made of this and no indication given of the extent of loss of bone which is capable of treatment by this method or the amount of loss which will inevitably lead to non-union, with the choice of wearing a dental appliance throughout life, or the alternative of bone grafting.

The method of allowing early approximation of the fragments with gradual replacement after callus is formed is also worthy of mention in this section. In fact, from reading this book the impression would be gathered that complete replacement should be obtained as soon as possible and if non-union results bone grafting should be carried out.

The author rightly insists on the greatest pains being taken to preserve the gingivo-labial sulcus, as if this is lost the after-fitting of a denture may be impossible.

The skiagrams illustrating this part of the book are not so convincing as the photographs on the plastic work.

If the subject matter of the book is recognized from its title it will be widely read by those members of the profession who are interested in this branch of war surgery and the experience of the author lends weight to the methods advocated which in his hands have yielded such good results.

The book is well produced, both the printing and illustrations are excellent. We notice a few misprints which should be corrected in future editions.

On page 8, the great "corner" of the hyoid bone should evidently be great cornua.

On page 10, the mention of "suture" of the common carotid artery in septic cases is probably a slip.

On page 27, line 3, "formed" is clearly a misprint for "found."

J. W. W.

REVIEW OF CHRONIC TRAUMATIC OSTEOMYELITIS. By J. Renfrew White, M.B. (N.Z.), F.R.C.S. Published by H. K. Lewis and Co. Ltd., London, 1919. Pp. xv. and 144. Price 12s. 6d. net.

The author opens his introduction with the following quotation from Leriche:

"Not enough thought is given to the life which those suffering from osteomyelitis are fated to lead in the future, with continued pain, sinuses constantly reappearing necessitating repeated operations which they must undergo without ever knowing how far away is the promised cure, or whether amputation will not eventually be necessary. Surely it is worth while to take any trouble that will save this long martyrdom."

In the effort to attain this object, i.e., the rapid and complete cure of chronic osteomyelitis, the result of gunshot fractures, this book has been produced.

There is no doubt that chronic osteomyelitis is at the present moment by far the most serious and common cause of prolonged disability in soldiers and pensioners, and apart from the danger and discomfort to the patients themselves must be a very serious financial problem to the State. A clear lead to the profession is absolutely necessary at the present moment on this important subject.

How little understood are the causes and treatment of chronic bone sinus can be quickly appreciated by anyone engaged in this type of surgery. One patient after another presents himself for treatment and the history is always the same. Either the sinus has never been healed since the original wound or it has only healed to break down again after a few days or weeks. The average number of operations these patients have undergone is usually about twelve.

Now, although few surgeons are going to undertake to cure a chronic sinus in one operation, yet this is frequently the case, and these patients would never have had to submit to this long martyrdom of operations if the pathology of the condition had been fully understood. Many of the operations that have been done for these unfortunate soldiers can only be described as a reproach to surgery.

This book deals with the subject in an exhaustive manner and every young surgeon who is beginning to undertake this class of surgery would do well to study it.

A thorough appreciation of the pathological changes that take place in a bone when a septic fracture has occurred is necessary to realize the operative steps required to cure it. The author has dealt with this part of the subject very fully in the opening chapters.

The point of most importance brought out by the book is the fact that the removal of sequestra and the scraping of the sinus are seldom sufficient to bring about a cure unless steps are taken to get rid of the bone cavity with its unyielding walls which prevent contraction.

The description of the radical operation is excellent, and if only this portion was read and the principles laid down carried into practice, the book would have fulfilled an important object. The author rightly insists that no operation should be undertaken on a bone sinus without a careful study of good stereoscopic skiagrams.

The illustrations, which consist principally of reproductions of X-ray prints, are very good and show clearly the different conditions which may be met with.

A further very important point brought out by the book is the choice of the

time for operation. If secondary necrosis is to be avoided the operation must be done at a quiescent period when all inflammatory trouble in the bone and surrounding tissues is at a minimum, and further, the wounds must be left wide open until it has become in every part a healthy granulating surface. The only criticism we would offer about this book is the tendency to "padding." The first chapter on the physiology of bone is unnecessary and the pathology is so fully dealt with in the first few chapters that it is rather uncomplimentary to the intelligence of the reader to so frequently revert to the pathological points in the various chapters.

This book should be in every hospital library where this type of surgery is dealt with, and if the principles laid down by the author are thoroughly and conscientiously carried out, it will do something towards wiping out the results of failure to attain primary sterilization of war wounds.

The book is well printed and the reproductions good.

J. W. W.

ELEMENTARY ORGANIC CHEMISTRY. By F. Pilkington Sargeant. Second Edition. London: H. K. Lewis and Co. Ltd. 1919. Pp. 100. Price 4s. net.

This little book, written by a pharmaceutical chemist, is adapted for the use of medical and pharmaceutical students, and is written for the benefit of the latter; nevertheless it will be found useful to those medical men studying materia medica, as it deals with the chemistry of many drugs.

There is no index, and a table of contents, giving the groups of substances, is not a satisfactory substitute in the case of students, who have little initial knowledge of the classification of the various compounds.

In a book of this size, a large amount of detail cannot be expected; but the author has contrived to give the reader a sound knowledge of the general principles of organic chemistry. It is written methodically and concisely, is free from any grave errors, and, but for the lack of an index, forms a useful book for elementary students.

F. E.

THE TRANSMUTATION OF BACTERIA. By S. Gurney Dixon, M.A., M.D. Cambridge University Press. Pp. xviii and 179. Price 10s. net.

In this monograph Dr. Gurney Dixon has brought together much evidence, collected chiefly from the English literature, on the subject of variation among bacteria. Having cited a number of instances of variation in morphology, fermenting power, virulence, and pathogenicity, he proceeds to consider the possibility of transmutation in the living body, and also deals with supposed instances of it brought about experimentally. Although he concludes that such transmutation has not yet been established, it is evident that Dr. Gurney Dixon is greatly impressed with the recorded instances of variation among bacteria, and to account for the facts he puts forward an "enzyme theory of disease" according to which the pathogenic effect of bacteria is due to their enzymes. On such a hypothesis bacteria may undergo change of character in regard to pathogenicity, without actual transmutation.

The fact of variation among bacteria will be admitted by most experienced bacteriologists. Bacteria are living micro-organisms that have survived largely because of their power of adapting themselves to their environment. But while a certain amount of variation is not uncommon in cultures on artificial media, there is an aspect of the pathogenic bacteria that is still more evident and impressive to those who are continually occupied in isolating and identifying them from patients, and that is the uniformity with which these micro-organisms conform to type. One of the most striking experiences of a hospital bacteriologist is the consistency with which a case of typhoid yields the typhoid bacillus, a case of pneumonia the pneumococcus, or a case of anthrax the anthrax bacillus when

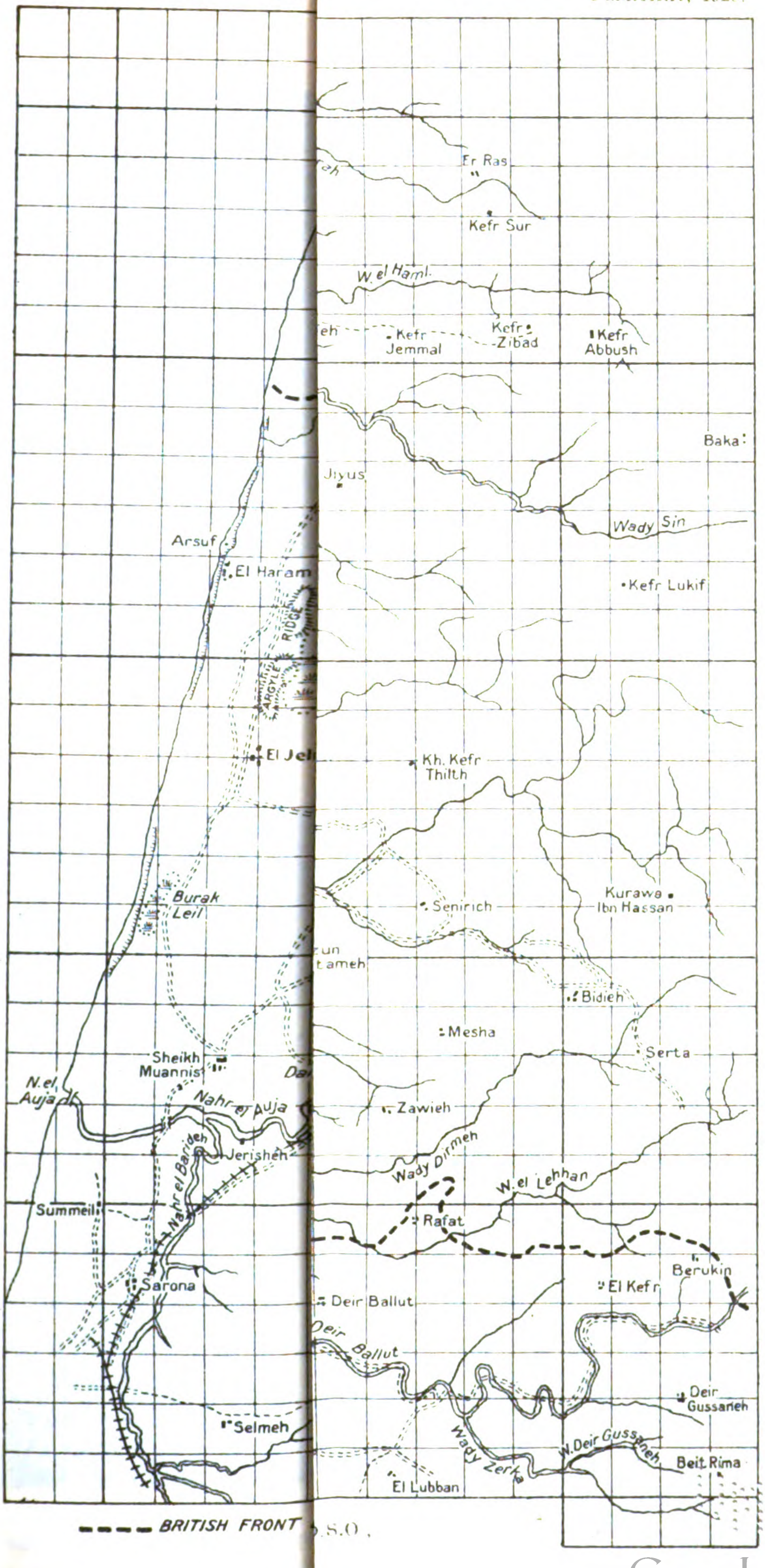
these micro-organisms are searched for under suitable conditions and in a correct manner. So constant are the characters of the pathogenic bacteria when freshly isolated that at the present time the responsibility of the diagnosis of these and other infections has come to rest chiefly on the shoulders of the bacteriologist; and as methods of specific diagnosis improve this will be still more so; for in its application to clinical medicine bacteriology is only at the beginning.

The doctrine of the transmutation of bacteria has an attraction for certain medicine philsophers whose mental attitude towards some infectious diseases presents a curious blend of a blind worship of Sydenham coupled with a profound distrust of modern bacteriological methods—except when these confirm their own particular views. The origin of their chief difficulty appears to lie in the alteration which an epidemic disease is apt to manifest in virulence from time to time. Now it must be admitted that at present we are ignorant of the precise machinery wherewith a specific pathogenic micro-organism increases its virulence. It is doubtful if speculation will ever help us to solve this problem: it is so easy to postulate the existence of some hypothetical factor such as a filtrable stage of the virus, or an added invisible agent, but it is quite another matter to prove the existence of these imaginings. The chief point actually determined so far appears to be that certain pathogenic bacteria when their virulence is raised are able to resist phagocytosis, whereas when in a less virulent condition they are readily taken up by the leucocytes.

The enzyme suggestion of Dr. Dixon does not help us much. In culture specific pathogenic micro-organisms undoubtedly possess *inter alia* enzymes which break down nitrogenous or carbohydrate material in their neighbourhood, and it seems reasonable to suppose that these and perhaps other enzymes come into play when these micro-organisms are in action *in vivo*. The hæmolytic, tryptic and histolytic effects of certain bacteria are apparently due to the action of bodies closely akin to enzymes. There is considerable doubt however whether endotoxin is of the nature of an enzyme, and the possibility also must be borne in mind of bacteria containing toxic principles of a chemical nature similar to those found in some of the higher fungi.

Dr. Gurney Dixon is to be congratulated on this monograph, which presents in a readable form the literature on a problem of great interest and importance. We understand that the present book is founded on a thesis submitted for the Doctorate of Medicine, and it is to be hoped that the Cambridge University Press from time to time may publish further theses in the same way. Hitherto we have had far too few British monographs. Full references to the literature are given at the end of the book. We should like to correct one misapprehension we have come across. In a reference to an outbreak of an influenza-like disease in East Herts in 1905 it is stated (page 112) that out of twenty-five strains of catarrhalis examined three fermented sugars. This is not correct. All of the specimens of catarrhalis gave the same negative sugar reactions; the three Gram-negative cocci that fermented sugars were clearly not specimens of catarrhalis at all, but quite distinct from that micro-organism.

M. H. G.



Er Ras
Kefr Sur
W. el Haml.
Kefr Jemmal
Kefr Zibad
Kefr Abbush
Baka
Jiyus
Wady Sin
Arsuf
El Haram
Kefr Lukif
ARGYLE RIDGE
El Jel
Kh. Kefr Thilth
Burak Leil
Senirich
Kurawa Ibn Hassan
Bidieh
Mesha
Serta
Sheikh Muannis
N. el Auja
Nahr el Auja
Zawieh
Jerisheh
Nahr el Barideh
Wady Dirmeh
W. el Lehhan
Summeil
Rafat
Berukin
Sarona
Deir Ballut
El Kefr
Deir Ballut
Deir Gussaneh
Selmeh
Wady Zerka
W. Deir Gussaneh
Beit Rima
El Lubban
BRITISH FRONT

S.O.

FIG. 1.—River Auja, near Ferrikiyeh, in its natural state.

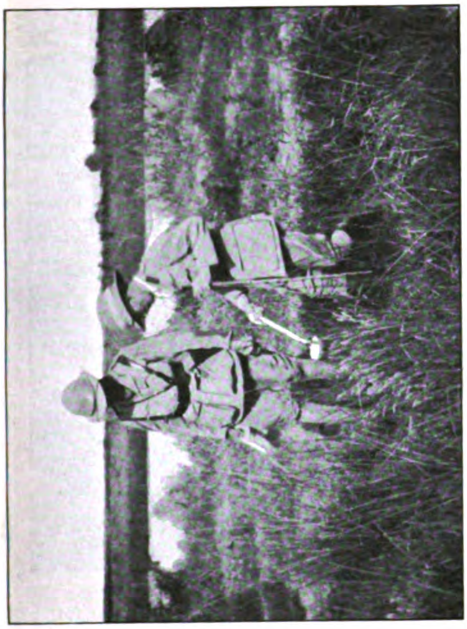


FIG. 2.—Marsh near River Auja.

FIG. 3.—Upper Auja, after clearing of banks.

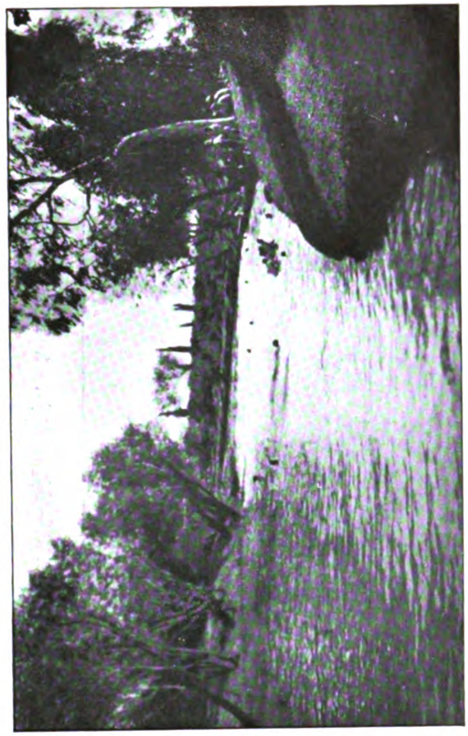


FIG. 4.—Upper Auja, after clearing of banks.

To illustrate "An Anti-Malaria Campaign in Palestine," by Col. E. P. SEWELL, C.M.G., D.S.O., R.A.M.C., and Brevet Major A. S. M. MACGREGOR, O.B.E., R.A.M.C. (T.F.).

FIG. 5.—Upper Auja, after clearing of banks.

FIG. 6.—Upper Auja, after clearing of banks.

FIG. 7.—Sikh Pioneers clearing banks 20 feet high, very steep and densely covered with trees, canes and brushwood.

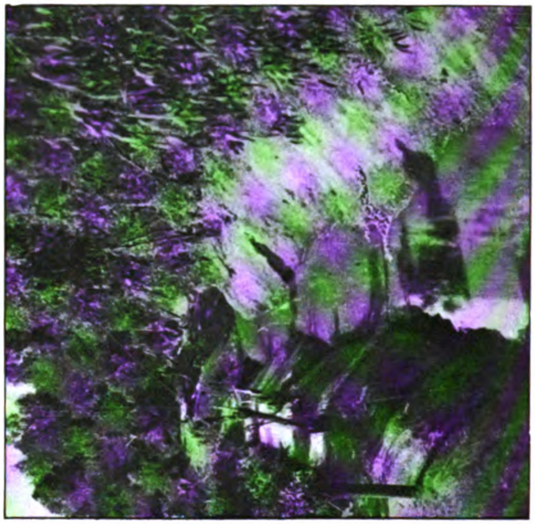
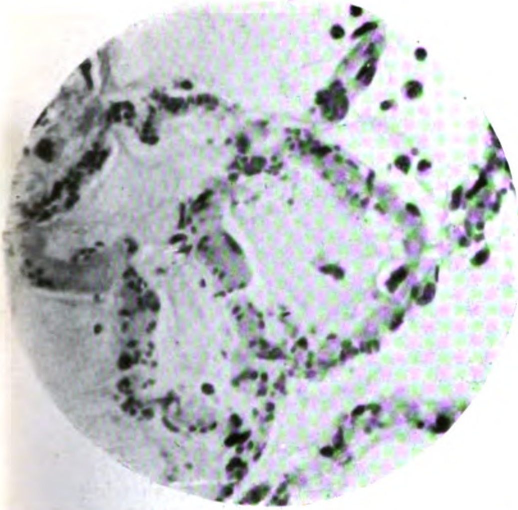
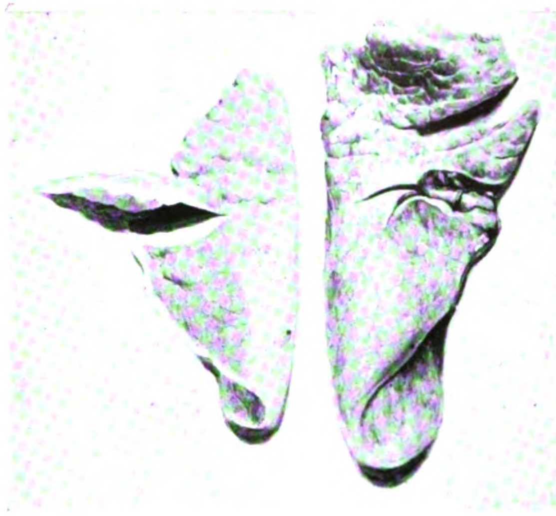


FIG. 8.—Wadi Ishkar, after clearing of banks.

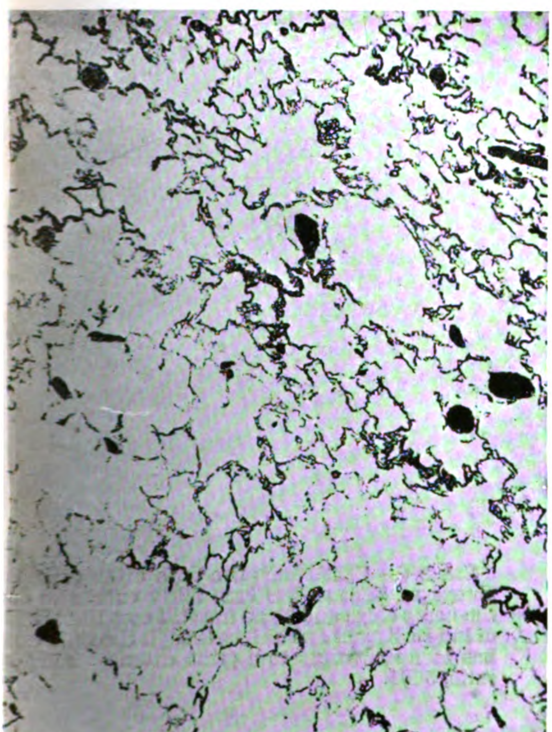
To illustrate "An Anti-Malaria Campaign in Palestine," by Col. E. P. SEWELL, C.M.G., D.S.O., R.A.M.C., and Brevet Major A. S. M. MACGREGOR, O.B.E., R.A.M.C. (T.F.).



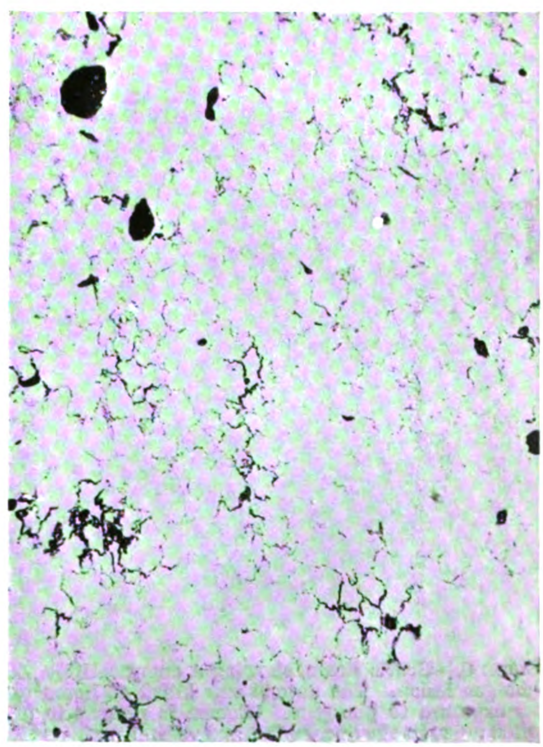
SLIDE 1.—Thrombosis of capillaries as seen 36 hours after exposure to phosgene. The capillaries are widely dilated and their lumina are filled by dense homogeneous masses. Numerous red corpuscles, which in the goat are of very small size, are entangled in the thrombi, appearing as dark dots. H.P.



SLIDE 2.—Normal lungs of goat. The lungs are in the collapsed condition in which they appear when the thorax is opened. Note appearance of lobulation on dorsal surface.



SLIDE 4a.—Gelatin injection of goat's lung 29 hours after exposure to phosgene; the mass was injected through the pulmonary artery. The section is unstained so that only the injected vessels are seen. In this area œdema was severe, but not completely solid. The injection of the capillary network is fairly complete. L.P.

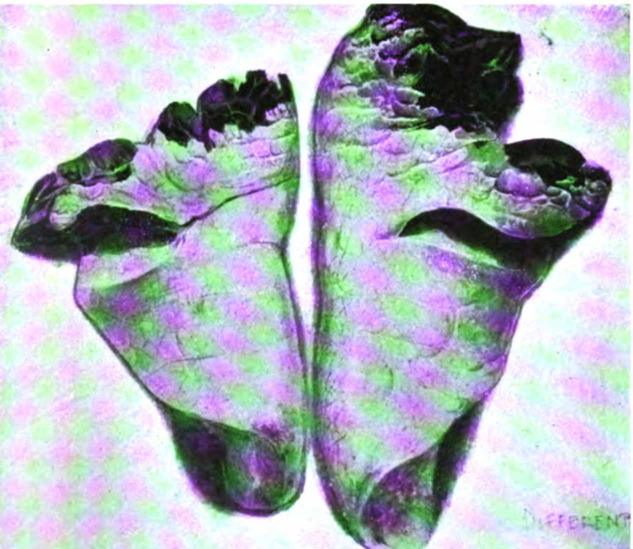


SLIDE 4.—Gelatin injection of goat's lung 29 hours after phosgene. This area was taken from the same lobe as that shown in SLIDE 4a, but here œdema was complete. The injection of the capillaries is notably imperfect. L.P.

To illustrate "Some Problems of the Circulation during Gas Poisoning," by JOSEPH BARCROFT, C.B.E., F.R.S.

SLIDE 3.—Lungs of goat one hour after exposure to phosgene (1 in 2,000, 20 mins.). The appearance of lobulation is unduly distinct as a result of œdematous thickening of the interlobular planes. The centres of the lobules, especially in the projecting ventral parts of the lobes, are reddened by early alveolar œdema. The lungs have collapsed almost normally. Lung-heart ratio, 3·2/1.

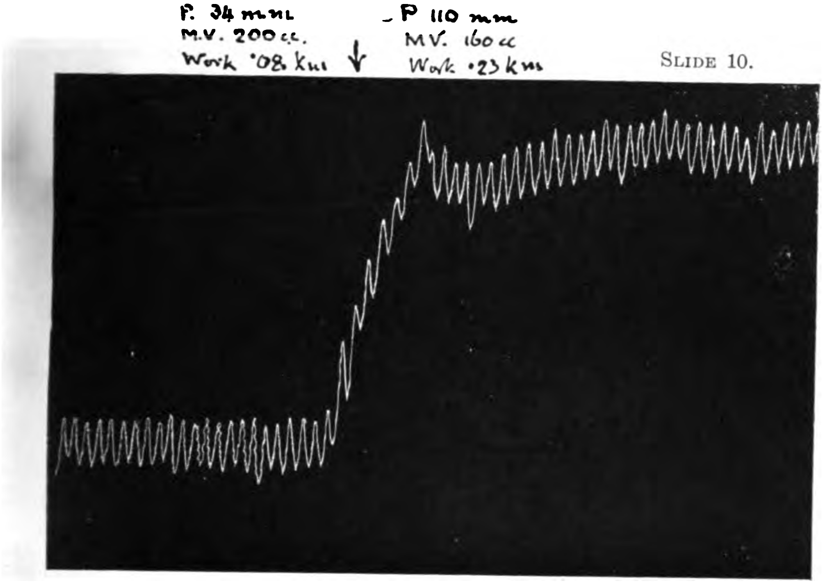
SLIDE 7.—Goat's lung showing moderately severe gas lesion, 48 hours after exposure to phosgene. Solid œdema is present in considerable areas, and most abundant ventrally. The intervening areas are almost free of œdema. Probably the worst stage is just past in this case and differentiation has begun. Lung-heart ratio, 3·9/1.



SLIDE 8.—Goat's lungs, showing a comparatively slight gas lesion. The animal was killed 48 hours after exposure to phosgene. Œdema is present in limited areas in the upper lobes and ventral margins of lower lobes. The affected portions are completely solidified, and are in sharp contrast with the rest of the lung which is fully aerated. A "differentiated" lung. Lung-heart ratio, 3·4/1.

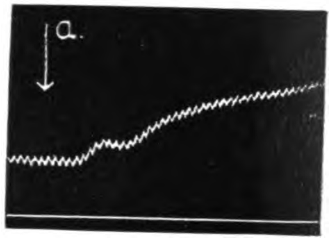
SLIDE 9.—Goat's lung five days after exposure to phosgene. Œdema has been fairly extensive during the acute stage and there are still considerable areas of lung collapsed and airless, though the fluid exudate has been reabsorbed to a great extent. Lung-heart ratio, 5·2/1.

To illustrate "Some Problems of the Circulation during Gas Poisoning," by JOSEPH BARCROFT, C.B.E., F.R.S.



SLIDE 10.

To illustrate "Some Problems of the Circulation during Gas Poisoning," by JOSEPH BARCROFT, C.B.E., F.R.S.



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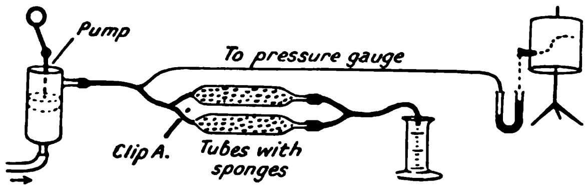
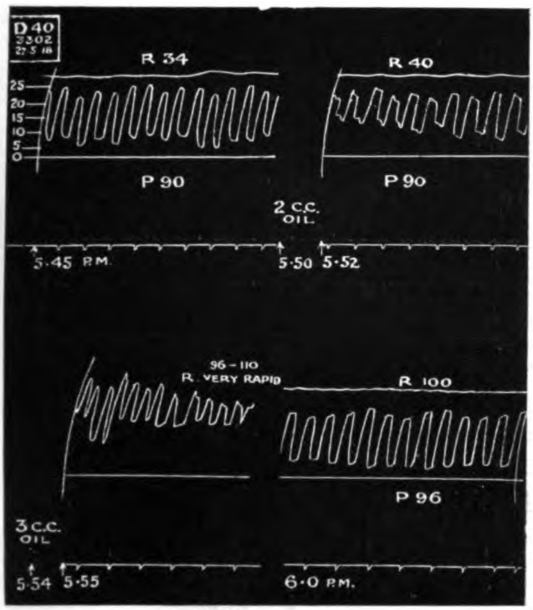


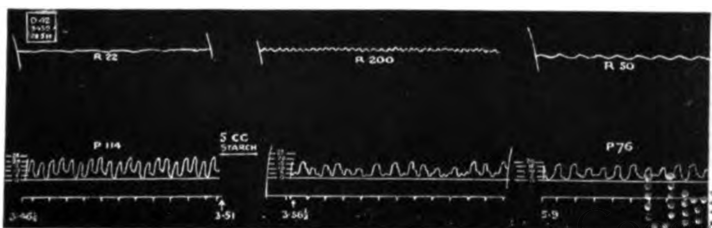
SLIDE 10.—Upper portion. Changes in pressure of model pulmonary artery due to restriction of "capillary bed."
Lower portion. Diagram of model circulation.



SLIDE 18.—Tracings of respiratory rhythm and normal right intraventicular pressure. R = respirations. P = pulse. Vertical scale = pressure in cm. of water. Time = seconds.

SLIDE 19.—Tracings of respiratory rhythm and normal right intraventicular pressure. R = respirations. C = pulse. Vertical scale = pressure in cm. of water. Time = seconds.

SLIDE 18.



SLIDE 19.

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DYSENTERY AND ENTERIC DISEASE IN MESOPOTAMIA FROM THE LABORATORY STANDPOINT.

AN ANALYSIS OF LABORATORY DATA DURING THE EIGHTEEN MONTHS ENDING DECEMBER 31, 1918.

By LIEUTENANT-COLONEL J. C. G. LEDINGHAM, C.M.G.
Royal Army Medical Corps.
Consulting Bacteriologist, Mesopotamian Expeditionary Force.

INTRODUCTORY.

THE data I have gathered together for analysis and presentation in the following paper represent the work of the bacteriologists in the Mesopotamian area on this subject during the period of my tenure of the post of Consulting Bacteriologist to the Force.

My acquaintance with laboratory conditions in Mesopotamia dated from September, 1916, when I visited the country as a member of the Medical Advisory Committee. This tour lasted about six months, during which I had ample opportunity of making the acquaintance of all the pathologists in the area, of inspecting laboratories, and making suggestions for improved facilities and more satisfactory organization generally.

Dysentery, diarrhœal diseases, and enterica bulked largely in the area during my first visit and advantage was taken of the autumnal dysentery prevalence in the last quarter of 1916 to suggest the carrying out of an inquiry into the nature of the epidemic, by careful examination of consecutive cases of acute dysentery. The investigation was carried out at No. 3 British General Hospital, Basra, under the superintendence of Captain Boney, R.A.M.C., and the published report (1918) showed clearly the great predominance of the bacillary type in the autumn epidemic of 1916.

On my return to the country in August, 1917, in the capacity of Consulting Bacteriologist to the Force, I very early decided that, if statistical use was to be made of laboratory data collected from a large number of laboratories situated in different parts of the area, one primary essential was the introduction of a return for laboratory findings which would at least ensure the presentation of data in a form capable of yielding comparable information. The question as to how far the accuracy of the statistics based on this form was to be affected by differences in the conscientiousness and reliability of the observers was left to settle itself, but every attempt was made to reduce such differences by such methods as the stereotyping of rules for the diagnosis of *Entamœba histolytica*, the classification for laboratory purposes of clinical dysentery types, periodical visits to laboratories, correspondence with workers, and the monthly distribution among all the laboratories of the area, of an analysis of the previous month's data. This latter analysis was prepared by the writer from the laboratory data returned monthly to headquarters and was, I believe, of much assistance to the laboratory workers generally who, otherwise, would have been ignorant of work and findings outside their own area.

Samples of the monthly laboratory form, the ward-laboratory forms, and the rules for guidance are appended, in order to indicate the nature and scope of the basal data on which this survey is founded. During my tenure of the post of Consulting Bacteriologist, the personnel of the laboratories did not alter much, at least in so far as the important first-class laboratories were concerned—a circumstance that conduced to uniformity and continuity of method.

Baghdad, Amara, and Basra had each a Central Laboratory, officered by well-known members of the Bacteriological Department of the Indian Medical Service. At these Central Laboratories the work performed was mostly in connexion with scientific inquiries into prevailing disease, chemical investigations and public health questions, but a certain amount of routine diagnosis involving cultural work was also undertaken on behalf of such hospitals as did not possess full laboratory facilities. All the British General and Stationary hospitals possessed or came to possess first-class laboratories capable of dealing completely with the bacteriological diagnosis of cases. Of the Indian General and Stationary hospitals, two only had facilities for cultural work. The others had to send their material for cultural work either to the nearest first-class laboratory, or, as was most usual, to the nearest central laboratory.

The total number of first and second-class laboratories, including central laboratories, was twenty-six, and they were distributed thus:—

Basra.—First-class laboratories: 1 Central Laboratory, 3 British general hospitals, 1 officers' hospital, 1 infectious hospital and 1 Indian general hospital. Second-class laboratories (microscopical work mainly): 5 Indian general hospitals.

Nasariyah.—1 first-class laboratory.

Amara.—First-class laboratories: 1 Central Laboratory, 3 British hospitals, and 1 Indian hospital. Second-class: 3 Indian hospitals.

Kut.—First-class laboratories: 1 British hospital. Second-class: 1 Indian hospital.

Baghdad.—First-class: 1 Central Laboratory, 3 British hospitals. Second-class: 2 Indian hospitals.

In addition to the above, certain casualty clearing hospitals provided with facilities for microscopical work gave monthly returns, and during the last quarter of 1918 returns were received from Hamadan and from the large refugee camp at Bakuba whither certain British and Indian hospitals with their laboratories had been drafted for duty.

Dysentery and Diarrhœa.

For laboratory purposes, dysentery and diarrhœa cases were divided into two groups according to the character, naked-eye and microscopical, appearances of the motion, viz.: (1) B. and M. group (i.e., blood and mucus) and (2) non-B. and M. group. The laboratory returns for the month yielded the percentage figure for the presence of *E. histolytica* in B. and M. cases, and non-B. and M. cases, and also for the successful isolation of *Bacillus dysenteriæ* in cases submitted to cultural examination.

Through the kindness of the headquarters staff, I was enabled to secure official[1] figures for admissions to hospital of dysentery, diarrhœa and "colitis," and also the official[1] strengths, both British and Indian, of the Force generally and its various areas.

An official return of "dysentery" was made or was understood to be made only when the patient was found to be passing blood and mucus. With this group of cases, the laboratory returns in connexion with the presence of *E. histolytica* or *B. dysenteriæ* in B. and M. cases were brought into relation. Under "colitis" and "diarrhœa" were officially returned cases of a milder type which were not understood to be passing blood and mucus. Doubtless, many cases returned under these unsatisfactory headings should have been returned as dysentery, but on this point more will be said later. It is sufficient to say here that the laboratory findings in the non-B. and M. cases (as determined by laboratory examination) were, for the purposes of this analysis, brought into relation with the incidence figures for official "colitis" and "diarrhœa."

Incidence of Dysentery and Diarrhœal Disease in British and Indians.

It is important, in the first instance, to note that the ratio of British to Indian strength in the whole area varied throughout the fifteen months under review from 1 : 2·6 to 1 : 3.

---

[1] These figures were extracted by myself from files placed at my disposal and are not to be regarded in the light of final official returns.

In the forward area the ratio remained fairly constant throughout the whole period at 1 : 1·6.

At the base (Basra) the proportion of British was considerably lower and varied throughout the period from 1 : 4·2 to 1 : 5.

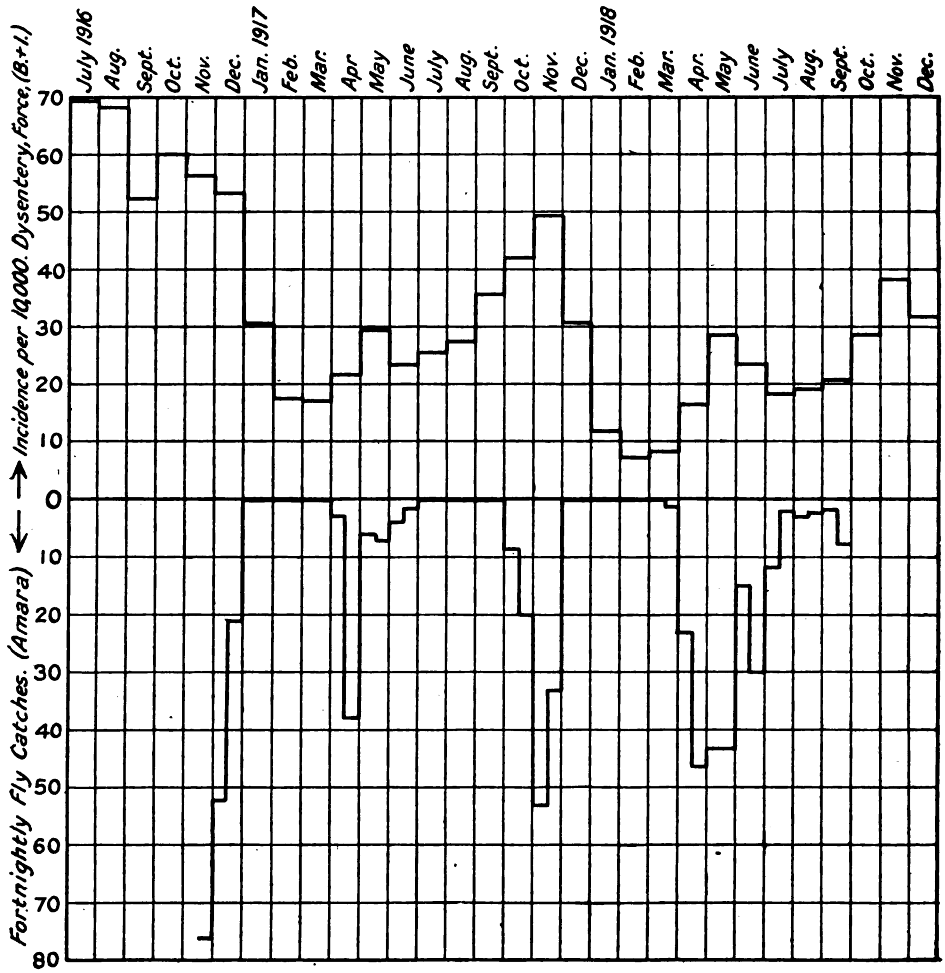


CHART 1.

The incidence of dysentery (combined British and Indian) throughout the area, from July 1916 to December 1918, is shown in Chart 1, the columns representing incidence per 10,000 per average monthly population. The admissions for the calendar months are obtained by adjustment on a uniform basis of the figures in the "week-ending" files. The columns prior to October 1917 are calculated from the weekly incidence rates for combined B and I dysentery. That the interpolation for months in this latter

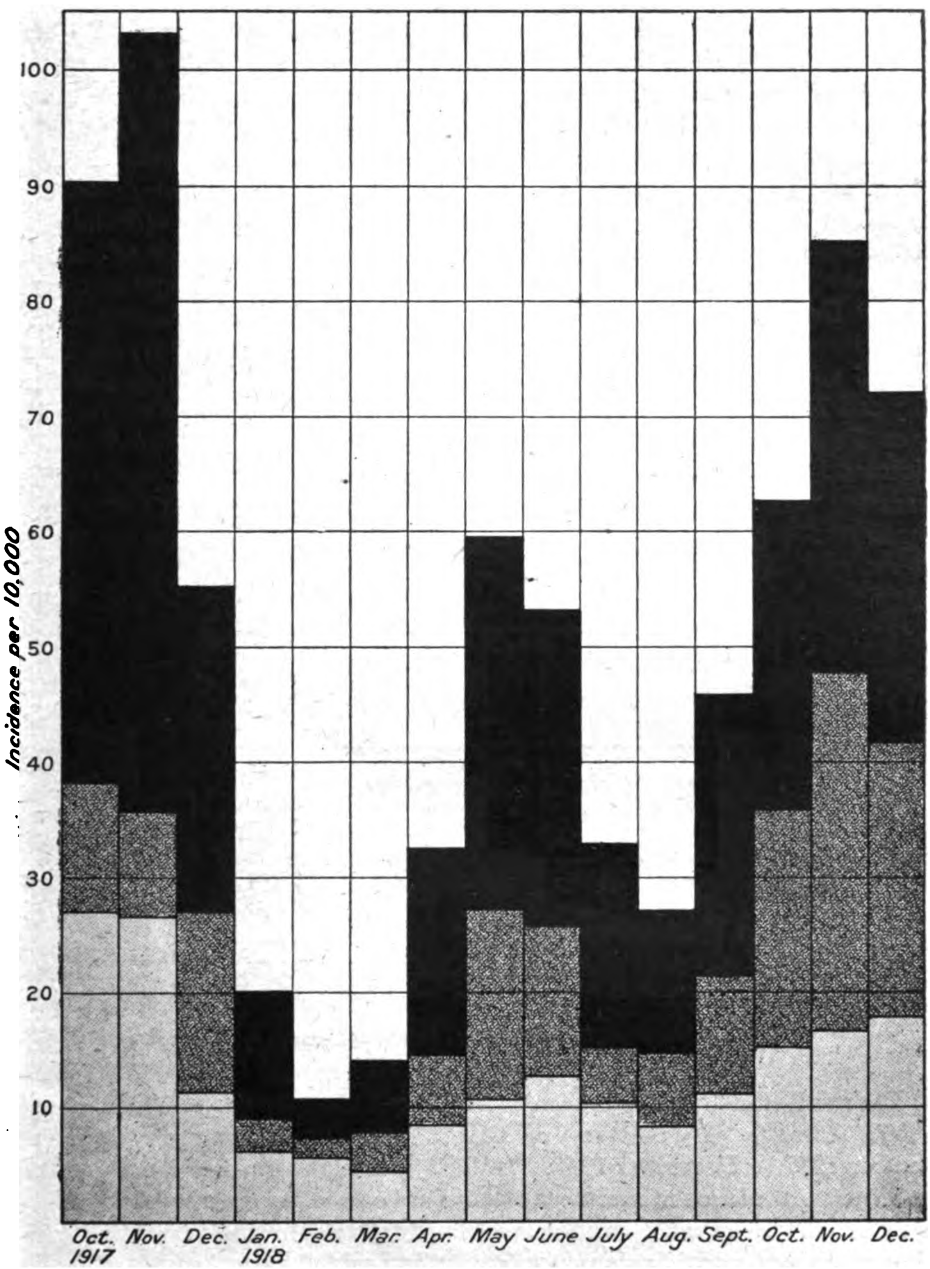


CHART 2.—Dysentery; Force, British.

period has been made on a principle not strictly accurate mathematically will not make any material difference to the general course of the dysentery prevalence, which is all that the chart is intended to show. The six months of 1916 show unusually high incidence columns for July and August, when the maxima exceeded those reached in the succeeding autumn epidemics. How far this is accounted for by inaccurate dysentery diagnosis and a loose clinical use of the term "dysentery," thus making the columns represent diarrhœal group incidence rather than dysentery incidence, I am unable to say. It may be that the spring epidemic of 1916 actually far exceeded in maximal incidence the autumn epidemic of that year which had its maximum in October, while subsequent years showed November maxima. The tall columns for July and August 1916, would therefore represent simply the aftermath of a great spring epidemic. In 1917 and 1918 the spring and autumn epidemics have their maxima in May and November respectively, and the epidemic-free months are in both cases February and March. In these latter months the incidence is minimal. The third quarter of the year assumes either a plateau-like character with an incidence never falling below that of April, the first month of the spring epidemic, or a gradual staircase form leading up to the autumn outbreak.

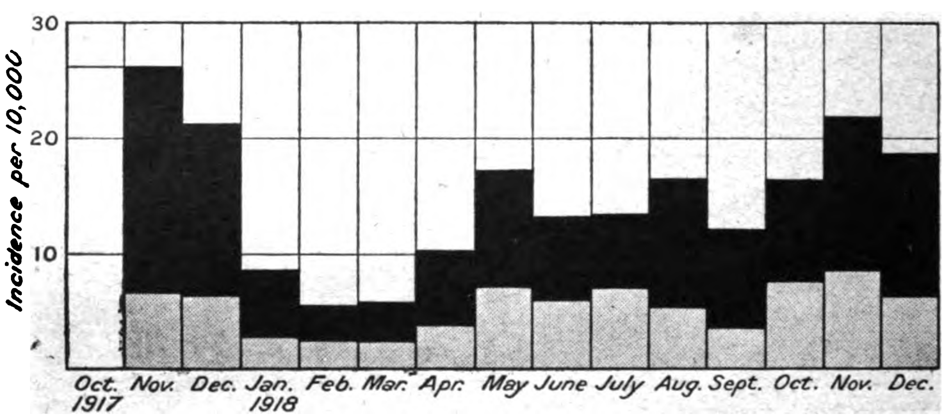


CHART 3.—Dysentery; Force, Indians.

Charts 2 and 3 (complete columns) show the monthly incidence per 10,000 strength of dysentery in British and Indians respectively from October 1917 to December 1918. In both charts the general course of the dysentery prevalence is similar but there are one or two marked differences apart from the enormous difference quantitatively in the respective incidences. In the British chart (Chart 2), the spring and autumn epidemics are more clearly cut. Further, while the third quarter dysentery aftermath in the British chart is seen to be composed of the termination of the spring outbreak and the first stage of the autumn outbreak with a

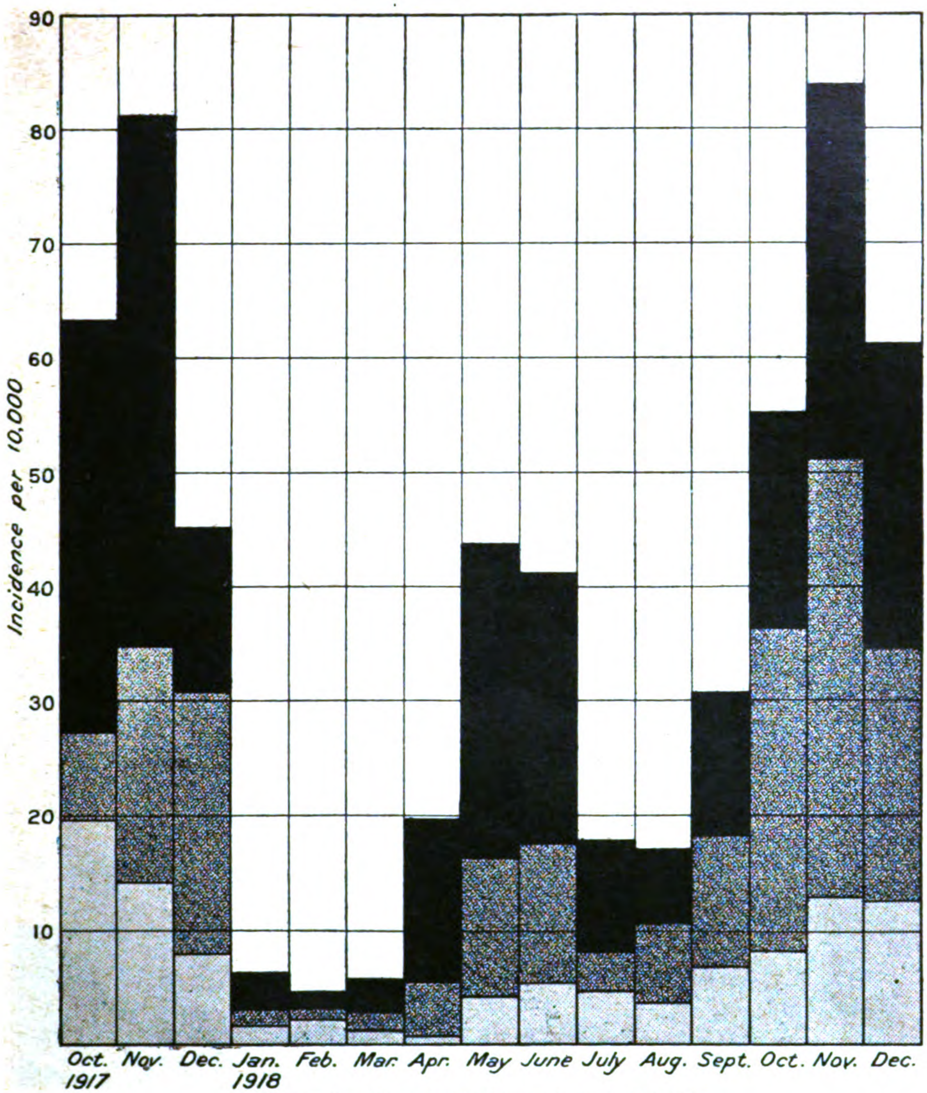


CHART 4.—Dysentery (Forward area), British.

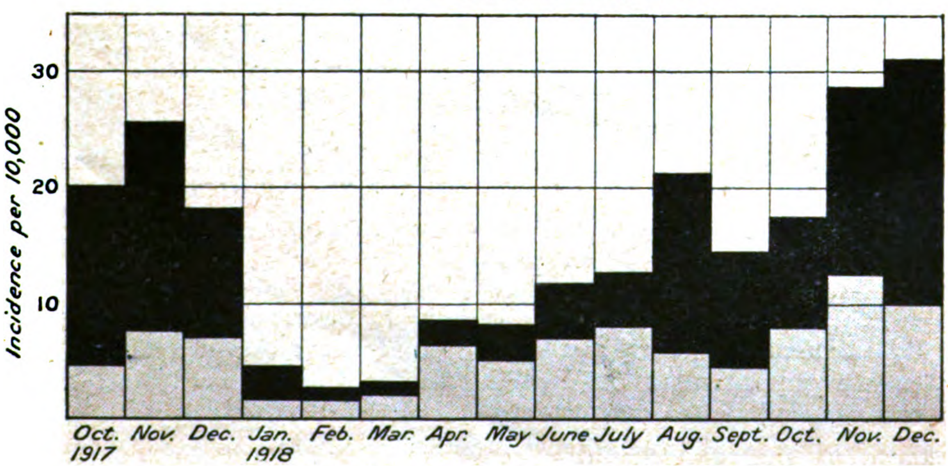


CHART 5.—Dysentery (Forward area), Indians.

minimum in August, the Indian aftermath shows a secondary rise in August, and the autumn outbreak appears to start later (in October instead of September as in British).

The following figures show the incidence variations in British and Indian:—

Minimal incidence in British (February)	10·9	per 10,000
Minimal incidence in Indians (February)	5·6	,,
Maximal incidence in spring outbreak in British (May)	59·6	,,
Maximal incidence in spring outbreak in Indians (May)	17·2	,,
Maximal incidence in autumn outbreak in British (November) ..	85·3	,,
Maximal incidence in autumn outbreak in Indians (November) ..	21·9	,,

The minimal February incidences and the two maximal incidences are thus connected in British and Indians:—

British:—as 1 : 5·4 : 7·8; Indian:—as 1 : 3 : 3·9, and as 5·4 : 7·8 : : 1 : 1·4 and 3 : 3·9 : : 1 : 1·3, it will be seen that the British and Indian maxima in the autumn epidemic bear practically the same quantitative relation to their corresponding spring maxima.

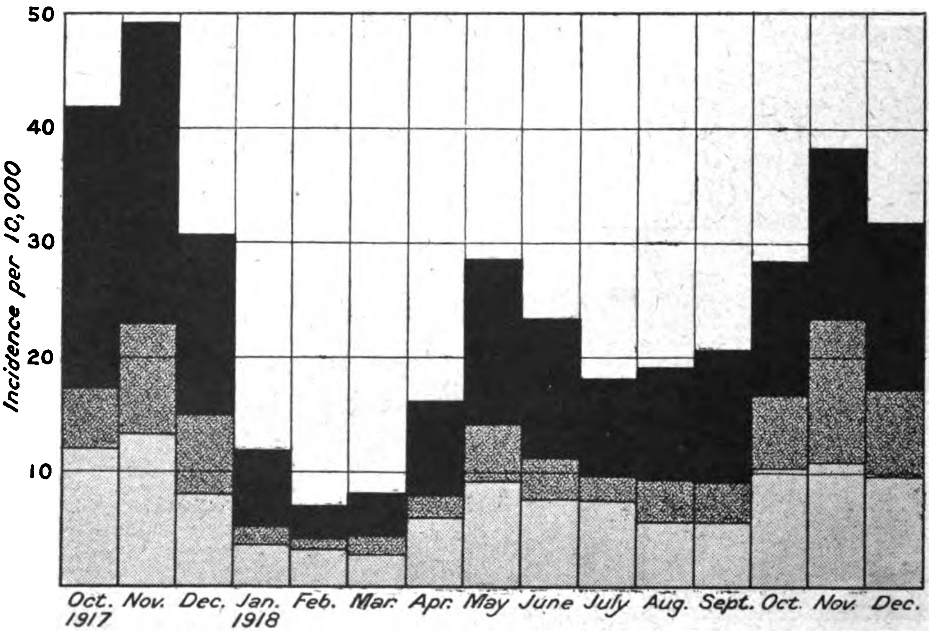


CHART 6.— Dysentery ; Force, combined B. and I.

The charts for the Forward area should theoretically provide the best indication of the general course of dysentery prevalence in a fighting force as the population of the Forward area is a homogeneous one and the environment, sanitary and otherwise, is more or less stereotyped.

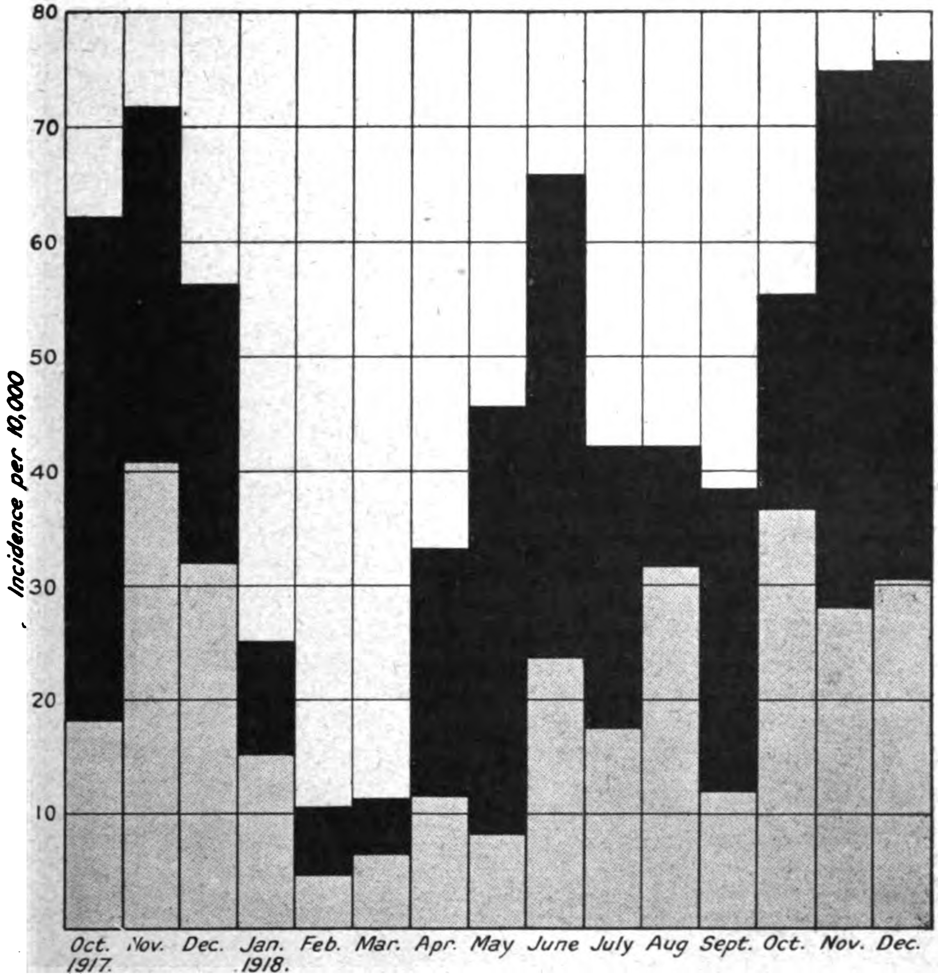


CHART 7.—Dysentery (Basra), British.

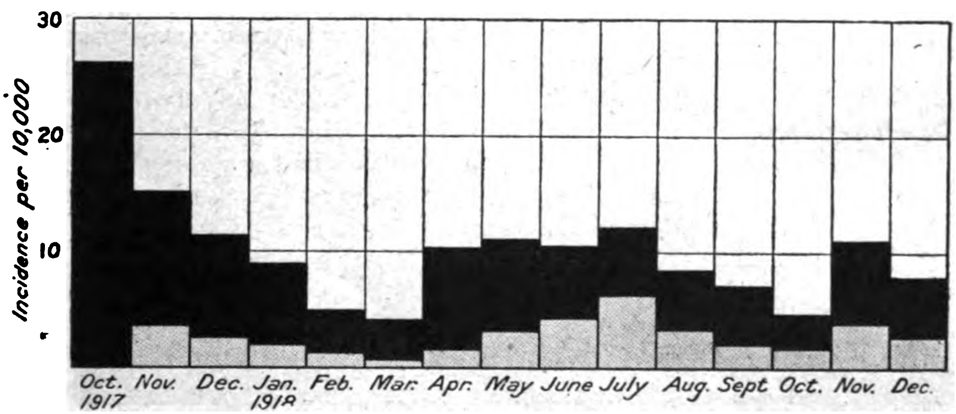


CHART 8.—Dysentery (Basra), Indians.

In the British chart the spring outbreak is very clear cut and the months of July and August form a true plateau with a level slightly below that of April. The autumn epidemic starts abruptly in September.

The Indian chart (No. 5) is somewhat puzzling. Here the curious increased prevalence or secondary epidemic in August is quite marked and the spring outbreak is small in comparison with it. In fact, there would appear to be three epidemic periods or periods of increased prevalence in Indian dysentery of the Forward area, as compared with only two in the British. Different factors which I am unable to suggest at present must be at work in the two cases.

Chart 6 forms part of Chart 1 already referred to. The general course of dysentery prevalence is seen to be determined by the British element.

The British chart (No. 7) has its spring maximum in June, a month later than in the Forward area, while the autumn outbreak starts in October. Otherwise the general course of the Basra and Forward area dysentery is similar. The Indian chart however (No. 8) takes an entirely different form from that of the Indian Forward area. The incidence in March is practically the same as that in October and both are minimal. The intervening prevalence is probably a summation of the usual spring outbreak with maximum in May and the secondary wave with maximum in July. The autumn outbreak occurs as usual though late, but it barely attains the dimensions of the spring-summer wave.

The following figures show the incidence variations in B. and I. in the Forward area and Basra respectively:—

Forward Area.	British	4·6 to 88·9	per 10,000	per month.
,,	,, Indian	2·9 to 31·6	,,	,,
Basra.	British	10·6 to 75·6	,,	,,
,,	Indian	4·1 to 11·0	,,	,,

DYSENTERY, DIARRHŒA AND "COLITIS."

These charts start from January 1918, when Diarrhœa and "Colitis" were added to the Special Diseases notification list. With regard to the British charts, their general course follows almost exactly that of British dysentery except that the incidence of "Diarrhœal" Diseases generally would appear to reach a higher maximum value in the spring rather than in the autumn. The Basra Indian chart reflects the character of the Basra Indian dysentery with a prevalence stretching from April to October.

The incidence variations in Diarrhœal Diseases are as follows:—

Forward Area.	British	10·4 to 197	per 10,000	per month.
,,	,, Indian	8·9 to 75·6	,,	,,
Basra.	British	24 to 138	,,	,,
,,	Indian	12·4 to 43·5	,,	,,

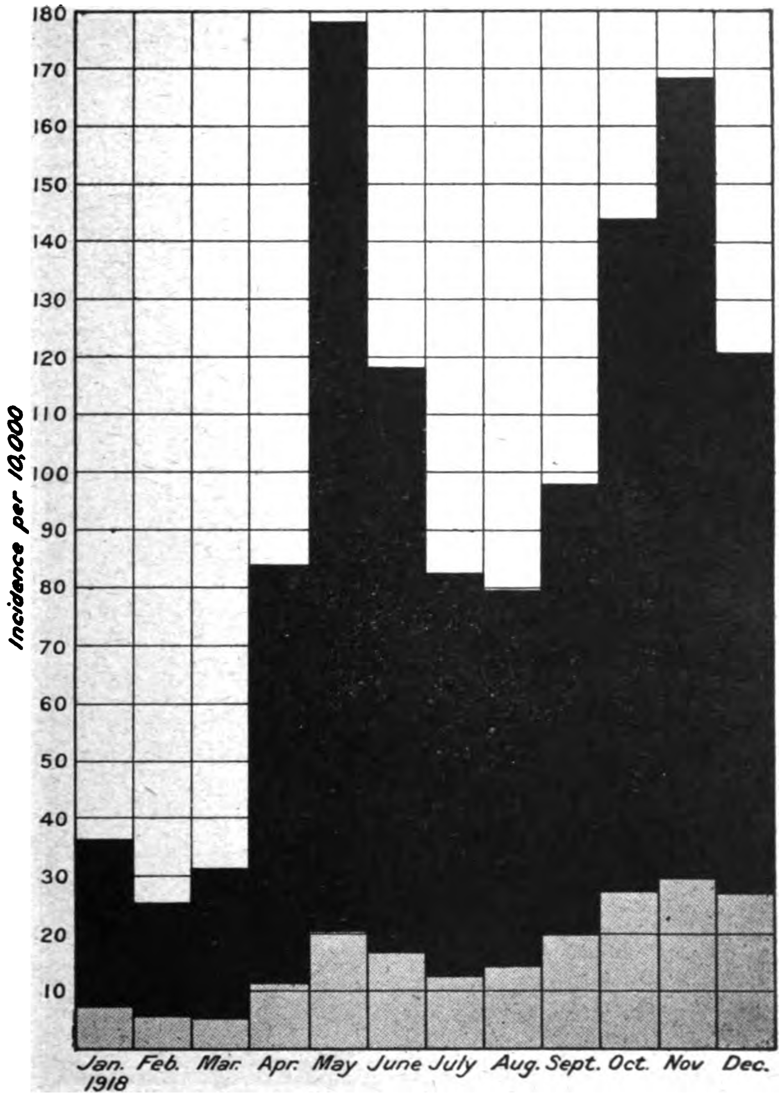


Chart 9.—Diarrhœal diseases (dysentery + colitis + diarrhœa); Force, British.

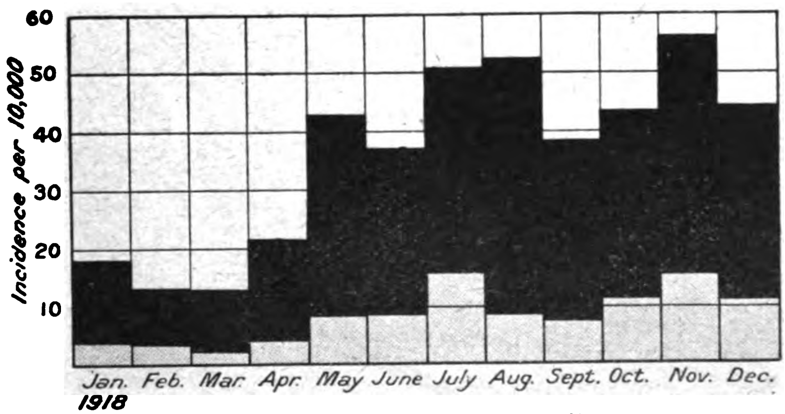


Chart 10.—Diarrhœal diseases; Force, Indians.

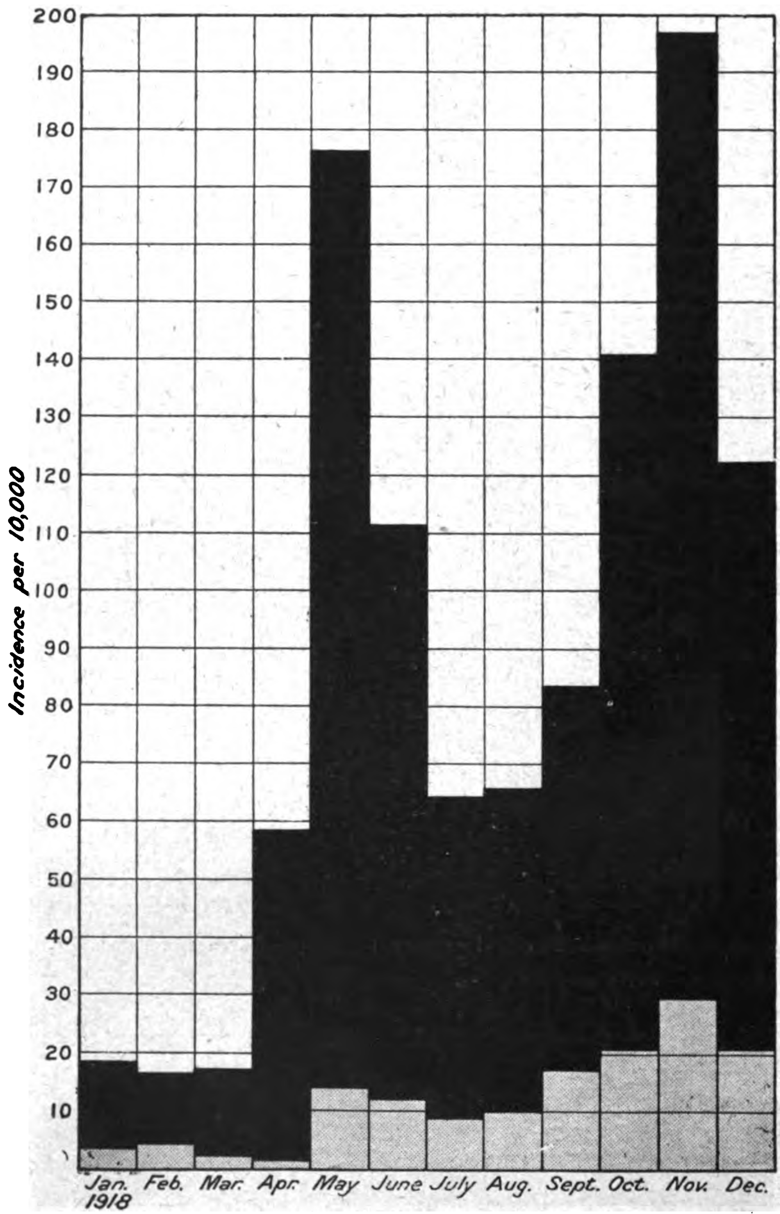


CHART 11.—Diarrhœal diseases; Forward area, British.

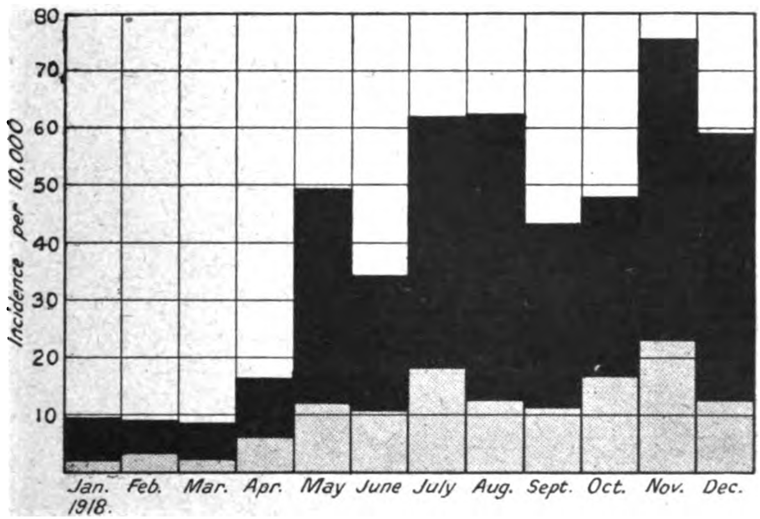


Chart 12.—Diarrhœal diseases; Forward area, Indians.

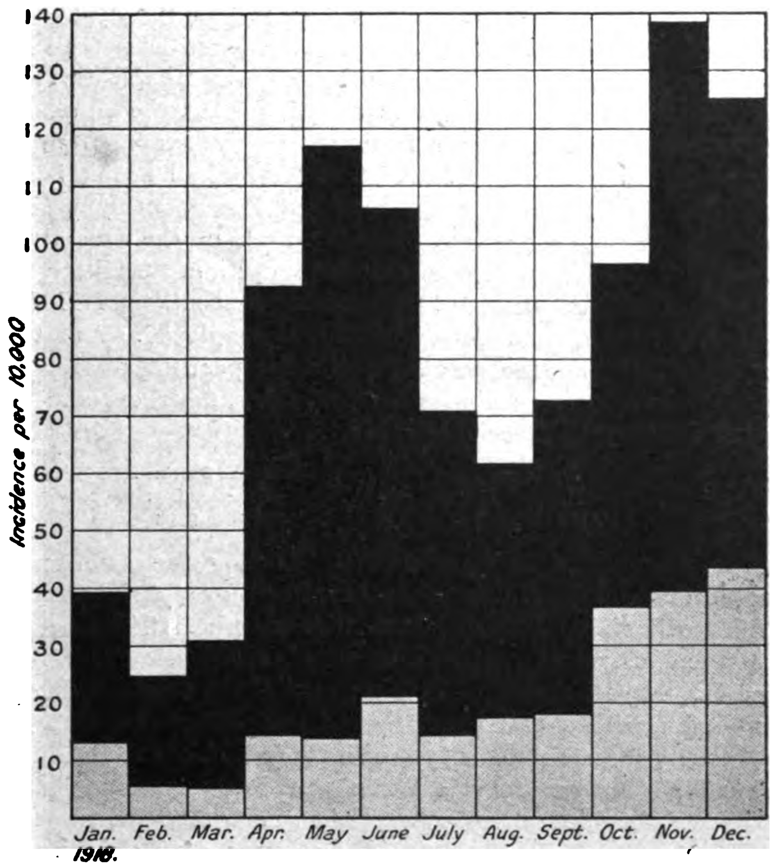


Chart 13.—Diarrhœal diseases; Basra, British.

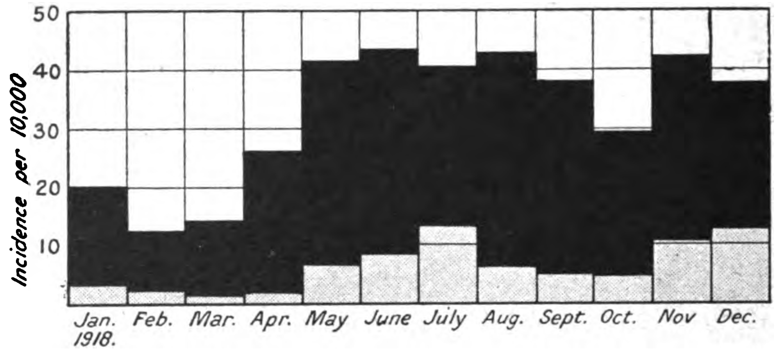


CHART 14.—**Diarrhœal diseases; Basra, Indians.**

NATURE OF THE DYSENTERY IN THE MESOPOTAMIAN AREA.

Returning to the charts already commented upon, attention is drawn to the lower portions of the columns. These represent that amount of the monthly incidence per 10,000 strength, which, according to the laboratory findings, is due to amœbic infection. In the dysentery charts, the basis of the calculation of amœbic incidence is the percentage of *E. histolytica* in B. and M. cases examined by the laboratories during the month. For the charts dealing with the whole area, the amœbic percentages corresponding to the various months are calculated from the mass results qua *E. histolytica* in B. and M. cases from all hospitals excluding those dealing with transfer cases mainly. The monthly percentage is then used to calculate the height of that portion of the general incidence column which is directly due to amœbic infection. Similarly in charts dealing with diarrhœal diseases, the monthly percentage of *E. histolytica* in all cases, B. and M. and non-B. and M. is employed. As a test of the validity of determining the amœbic incidence per 10,000 strength in this way, let us take the force figures for dysentery, diarrhœa and colitis for the period January to December, 1918.

Dysentery.		Colitis and Diarrhœa.	
B.	I.	B.	I.
5492	4937	6927	9286

The total notifications were 25,642. During the same period, the total dysentery and diarrhœa cases examined by the laboratories were 24,667. Also Baghdad British laboratories examined 94·8 per cent of the dysentery and diarrhœa notifications in advanced section, while Indian Baghdad laboratories examined 71·6 per cent of the total. With regard to the Forward area, a small proportion of the dysenteries were examined microscopically at certain casualty clearing hospitals, but the results obtained at Baghdad laboratories may be taken as a fairly accurate guide to the nature of the diarrhœal disease prevalent among the fighting troops.

As there are two main causes of dysentery operating in the area,

(*E. histolytica* and *B. dysenteriæ*) it is of the greatest importance to ascertain what part each plays in the spring and autumn outbreaks and in the epidemic-free periods. This problem has engaged considerable attention both on the part of bacteriologists and clinicians working on various Eastern war fronts, since the notable outbreak in the Dardanelles in 1915. In that outbreak, both amœbæ and *B. dysenteriæ* played a part and while some assigned a greater importance to *E. histolytica* as the main "epidemic" agent, others inclined to the view that by far the major portion of the dysentery was of bacillary origin. The latter view was more fully substantiated by subsequent investigation in 1916 and, since then, the main epidemic agent of dysentery both in Egypt and in the Salonica area has undoubtedly been *B. dysenteriæ*.

It has to be remembered that in work of this kind the rôle of *E. histolytica* in a sample of acute dysenteries can be very accurately defined as, in the opinion of most experts, *E. histolytica* in the vegetative form can be demonstrated by single examination in well over ninety per cent of untreated amœbic dysenteries examined in the early days of the disease. At a later stage the finding of the characteristic cysts clinches the diagnosis. It is otherwise with *B. dysenteriæ*, to isolate which, with reasonable prospect of success, it is important to secure samples at the earliest period of the disease. Moreover, apart from this difficulty, which only good ward-laboratory co-operation can successfully combat, the technical work involved in cultural investigation cannot be compared with the simple microscopical demonstration of a living amœba. Consequently, quantitative results qua amœbic percentage are by no means strictly comparable with quantitative results qua *B. dysenteriæ*. My own view is —and it agreed with clinical opinion in Baghdad—that in an epidemic season practically all the non-amœbic acute dysenteries may fairly accurately be regarded as bacillary (see later data on this point), The test of the predominance of *B. dysenteriæ* during an epidemic period must be a fall in the percentage of *E. histolytica* from that reached in the month prior to the epidemic. If the amœbic percentage falls the excess of cases must be due to bacillary infections. If the amœbic percentage remains fairly constant or even rises somewhat, the epidemic may be considered as the resultant of two forces, one of which, however, will always be more prominent than the other, in view of the fact that *E. histolytica* percentages in B. and M. cases have only in exceptional circumstances exceeded fifty per cent.

(*To be continued.*)

AN ANTI-MALARIA CAMPAIGN IN PALESTINE.

An Account of the Preventive Measures undertaken in the 21st Corps Area in 1918.

By Colonel E. P. SEWELL, C.M.G., D.S.O.
Royal Army Medical Corps.

and

Brevet Major A. S. M. MACGREGOR, O.B.E.
Royal Army Medical Corps (T.F.).

(*Continued from p.* 100.)

(6) *The Auja River.*—The problem of dealing with this river was a most formidable one. If it were necessary to train the banks for the whole course of the river—a distance of fifteen miles—the task was indeed a gigantic one. But was it necessary? Would anophelines breed in the rapidly flowing current? Would not the fish, in which the river abounds, and other natural enemies of the larvæ destroy them as rapidly as they hatched out? Such questions naturally presented themselves, and found no definite replies. An expectant policy was inevitable, not only on account of this uncertainty, but also because all available labour was fully occupied in working on the more urgent parts of the scheme, including the clearance of the upper part of the river, and the drainage of the swamps along its banks between El Mirr and Ras el Ain. The more this part was cleared of reeds and other vegetation, the more it was realized what an immense task we had undertaken. Fresh springs and swamps were found everywhere, and to make matters worse, in the middle of May anopheline larvæ were found among the reeds and rootlets of willows along the edge of the main stream in its upper part. This showed that no time was to be lost, and as the British labour working on this portion of the river was making very slow progress, a battalion of Sikh Pioneers (1/34th) was obtained and put on to assist. The results they produced were astounding. They appeared to enjoy the work thoroughly, and wading and swimming in the river, hauling at trees and hacking at undergrowth, in three weeks they cleared the banks so completely and trained the edges so thoroughly for a distance of five miles that very little maintenance was required during the rest of the summer. This portion included the difficult reach between Mill Race and Ferrekhiyeh, where the banks were some twenty feet high, precipitous, and covered with an impenetrable mass of undergrowth.

The area around Ras el Ain Castle was also taken in hand. This was a very difficult area to deal with, consisting as it did of acres of dense jungle formed of grass, thistles, brambles and reeds, underneath which concealed springs bubbled up from the ground and formed little channels of water which joined other little channels and formed a network of streams. In

the midst of this jungle large shells had fallen and left deep shell holes which soon filled with water. Moreover, the work was hampered by the enemy, who shelled any working party of more than five or six men. In spite of all these difficulties the work was accomplished. The jungles were cleared and burnt and the streams canalized, until by the end of July the situation was so well in hand that it required a long search to find a single larva.

At the same time gangs of Egyptian labourers were busy clearing the banks of the middle and lower reaches of the river of grass, reeds and other vegetation which might impede the flow of water, and afford a harbourage for mosquito larvæ. These operations included the clearing of the streams and backwaters in the neighbourhoad of Hadrah Mill, where a dam had been constructed for the working of the mill. Owing to the slowing of the current by this dam a plentiful growth of reeds was encouraged, which were all cut down and cleared away. A particularly dangerous spot was found in a backwater below the dam, where the surface of the water was covered with water lilies and the banks overgrown with vegetation. This backwater was completely cleaned up, and a channel cut, which allowed a current of water to sweep through the backwater and prevent stagnation.

There remained three main tributaries joining the Auja on its north side. These wadis, which had their origin in the enemy's lines, and which traversed "No man's land," were a source of much trouble and anxiety. A large portion of them could only be dealt with at night, as working parties were under enemy observation, and the Turks did not seem to appreciate the fact that the destruction of mosquito breeding places was as beneficial to them as to ourselves. The three wadis were named Wadi Ishkar, Wadi Rabah and Wadi Dhaheb. The Wadi Ishkar had a branch known as the Wadi Adas. The work of clearing and draining these wadis was undertaken by parties of Infantry working under the directions of the C.R.E., 54th Division, and C.R.E., 7th Division, and it was carried forward as far as possible towards the Turkish lines. The Wadi Ishkar gave the most trouble, and required constant supervision and maintenance after the work of clearing and channeling had been completed. It could not be completely obliterated like the Wadi Abu Lejja owing to the presence of springs in its course. Its banks were the steepest and most densely overgrown of any of the wadis dealt with. The flow of water was very sluggish and several long and deep pools were found in its course. It appeared to be especially beloved by anophelines as a breeding place, and any blocking of the stream by debris or by algal growth, which developed with surprising rapidity, was quickly taken advantage of as a nursery. The work on the upper part for a distance of over 1,500 yards above the Ishkar Bridge was done by the 54th Division, and the portion below the bridge by the 7th (Indian) Division. The whole was completed by June 13, but at a later date it was found possible to fill in the wadi above its junction with Wadi Adas at Ishkar Bridge, and this was done before the end of July.

In the lower portion, however, a sluggish flow of water continued, and efforts to keep the surface oiled were made. This, however, was not very successful until the 3rd Division took over the area, and devised the scheme of placing across the stream at intervals corrugated iron sheets with their lower edge dipping a few inches below the water. At the head of each reach so formed an oil drip-can was placed, and by this means a satisfactory film of oil was maintained, stretching upwards from the barrier. A mixture of equal parts of heavy oil and kerosine was found most suitable for this and similar work, as the resulting film lasted longer than that formed by kerosene alone.

At a distance of 1,500 yards above the Ishkar Bridge pools existed, and these were so close to the enemy's lines that nothing could be done to them except an occasional oiling by a patrol. Doubtless considerable breeding took place in these pools and accounted for the large numbers of adult *A. maculipennis*, which could always be found in Ishkar Wood, and which caused a certain amount of malaria in that area.

After the clearance of the Auja and its tributaries constant watchfulness had to be exercised to prevent breeding. The chief danger spots were the small backwaters formed at the junction of little tributary wadis. When breeding was found these were revetted and filled in if possible; if not, they were oiled twice a week.

In another place breeding was discovered under somewhat unexpected conditions. Debris, consisting of small twigs, bits of rushes and leaves washed down from the clearing work going on higher up the stream, collected in the sluggish waters above Hadrah Dam. In these collections of debris young anopheline larvæ were found in numbers, and this entailed clearing away all such debris whenever it collected.

Yet another nidus was taken advantage of by anophelines. During June in the reaches between Hadrah and Jerisheh dams, a rapidly growing, dark-coloured, closely matted weed began to appear. Towards the end of the month it was discovered that anopheline larvæ were present in these masses of weeds, some of which grew almost in mid-stream. The weed was at once torn up, but it is probable that breeding had been going on for some time before it was noticed.

All anti-malarial work ceased in the 21st Corps Area on September 19, when the attack was made, which drove the Turks from their positions and resulted in the capture or destruction of the whole Turkish Army and the end of the campaign. On this date the whole corps moved forward into malarious country, which had received no attention from the enemy, with the result that malarial infections among the troops became very numerous during the last three months of the year. This, of course, was inevitable and the price of victory; but, as far as the results of the anti-malaria campaign on the Auja line are concerned, it was unfortunate, since the work came to an abrupt and premature conclusion, and the full effects of the operations cannot be gauged. The number of cases of malaria

occurring during the late autumn would have provided the true test of the efficacy of the operations, but, owing to the advance, these figures cease to bear any relation to number of infections acquired in the area under consideration. Accurate returns are, however, available up to the end of September, and the effect of the operations as shown by them will now be discussed in detail. One fact, however, must be clearly borne in mind, and that is that although the major works of clearing and channeling had been completed, constant vigilance and increasing works of maintenance would have been necessary for another two or three months in order to prevent breeding. As illustrating this fact, it was recorded by the A.D.M.S., 3rd (Lahore) Division that on October 6—twenty days after anti-mosquito measures had ceased—anopheline larvæ could be found with ease in many of the pools round Ras el Ain, and adult *A. palestinensis* were numerous in that locality.

V.—The Cost of the Operations.

An estimate of the cost of these operations may be interesting. In the six months during which the work was carried out the amount of labour employed, as estimated by the Royal Engineers, was 222,840 men-days. Estimating food and wages at 3s. a day, the cost of labour, if civilians had been employed, would have amounted to £33,426.

If to this be added the cost of technical services, pumps, and other material employed, the total amount for the six months' work could not have fallen below £40,000.

This sum, large as it is, was a small one to pay for the smashing victory over the Turks which would have been impossible if the anti-malarial work had not been carried out. But it is a sum which gives food for thought in contemplating the future of Palestine and the wider question of making the tropics and semi-tropics habitable for the white man.

VI.—Incidence of Malaria among the Troops of 21st Corps during Summer, 1918.

Statistics showing the number of cases of malaria reported weekly are given in comprehensive form in Table II, for Divisions and Corps Troops separately and combined.

As it is important to consider whether the statistics given reflect with any degree of accuracy the actual incidence of malaria, the procedure adopted in diagnosing infections may be briefly described. Diagnosis depends, of course, on facilities for prompt examination of blood films. Two malaria diagnosis stations specially designed for microscopic work in the field were placed at the disposal of the corps and located at centres convenient to the main bodies of troops. The procedure laid down for medical officers was that a blood film should be taken in every case of fever, before giving quinine, and submitted for examination to the Malaria

TABLE II.

	7th Division							54th Division							3rd Division						
Week ending	Strength of formation	Total cases	Rate per 1,000	Benign tertian infection	Sub-tertian infection	Type not stated or diagnosed clinically	Recurrent infection	Strength of formation	Total cases	Rate per 1,000	Benign tertian infection	Sub-tertian infection	Type not stated or diagnosed clinically	Recurrent infection	Strength of formation	Total cases	Rate per 1,000	Benign tertian infection	Sub-tertian infection	Type not stated or diagnosed clinically	Recurrent infection
May 4	20,419	16	0·78	16	..	..	12	15,774	6	0·38	5	..	..	2	..	..	..	..	..	..	..
,, 11	20,422	5	0·24	5	..	..	5	15,864	9	0·56	8	..	1	3	..	..	..	..	..	..	..
,, 18	20,343	11	0·54	10	..	1	7	15,638	11	0·70	11	..	..	8	..	..	..	..	..	..	..
,, 25	21,300	13	0·61	12	1	..	7	15,391	20	1·29	19	..	1	16	..	..	..	..	..	..	..
June 1	20,724	3	0·14	3	..	..	1	15,666	17	1·08	12	..	5	9	..	..	..	..	..	..	..
,, 8	19,794	18	0·90	9	9	..	6	15,945	18	1·12	16	1	1	9	..	..	..	..	..	..	..
,, 15	19,679	52	2·64	37	14	1	18	15,693	43	2·76	40	2	1	21	..	..	..	..	..	..	..
,, 22	19,187	89	4·63	74	14	1	34	16,013	34	2·12	29	3	2	9	..	..	..	..	..	..	..
,, 29	19,135	102	5·33	91	11	..	40	..	28	..	22	4	2	5	..	..	..	..	..	..	..
July 6	18,157	113	6·22	103	10	..	33	11,465	31	2·70	26	6	..	2	17,848	18	1·0	8	4	6	6
,, 13	17,961	240	13·37	211	28	1	67	15,734	64	4·06	55	7	2	13	18,550	32	1·18	32	..	..	15
,, 20	18,815	276	15·06	263	13	1	91	15,533	151	9·72	120	31	..	24	18,543	47	2·53	44	3	..	12
,, 27	17,729	179	10·09	167	12	..	69	15,444	51	3·30	49	1	1	17	18,579	122	6·56	110	12	..	20
Aug. 3	19,293	331	17·15	310	20	1	96	15,670	36	2·29	31	1	4	12	18,975	186	9·80	169	16	1	17
,, 10	19,268	272	14·11	245	27	..	86	15,454	36	2·33	32	4	..	7	18,445	264	14·32	233	30	1	19
,, 17	18,950	280	14·77	241	30	9	90	14,776	35	2·36	31	3	1	10	17,945	369	20·56	296	72	1	25
,, 24	18,123	331	18·26	273	48	10	56	14,025	58	4·13	45	3	10	14	17,787	218	12·25	176	42	..	4
,, 31	18,809	269	14·30	234	24	11	66	13,844	38	2·74	27	5	6	15	17,775	289	16·25	239	49	1	48
Sept. 7	18,743	210	11·20	191	11	8	91	15,367	50	3·25	39	7	4	11	18,619	178	9·56	144	33	1	21
,, 14	18,479	239	12·94	207	22	10	80	15,705	44	2·80	32	5	7	11	18,619	184	9·88	133	51	..	28
,, 21	19,292	107	5·55	79	18	10	16	13,748	60	4·36	38	10	12	13	17,217	138	8·01	96	34	8	18
Totals	..	3,156	..	2,781	312	64	971	..	840	..	687	92	60	231	..	2,045	..	1,680	346	19	228

TABLE II—*Continued.*

Week ending	75th Division: Strength of formation	Total cases	Rate per 1,000	Benign tertian infection	Sub-tertian infection	Type not stated or diagnosed clinically	Recurrent infection	Corps Troops: Strength of formation	Total cases	Rate per 1,000	Benign tertian infection	Sub-tertian infection	Type not stated or diagnosed clinically	Recurrent infection	Total: Strength of formation	Total cases	Rate per 1,000	Benign tertian infection	Sub-tertian infection	Type not stated or diagnosed clinically	Recurrent infection
May 4	16,953	6	3·53	3	..	3	6	6,309	5	0·79	5	..	..	4	59,455	33	0·55	29	..	4	24
,, 11	16,117	17	1 05	9	1	7	13	8,393	6	0·71	6	..	..	3	60,796	37	0·6	28	1	8	24
,, 18	14,985	4	2·66	3	..	1	3	6,227	12	1·92	12	..	..	11	57,193	38	0·66	36	..	2	29
,, 25	14,968	10	0·66	6	..	4	10	7,943	..	..	..	..	..	..	59,602	43	0·72	37	1	3	23
June 1	14,744	1	0·06	1	..	..	..	7,854	3	0·38	3	..	..	3	58,988	24	0·42	19	1	5	13
,, 8	16,170	15	0·92	12	1	2	9	8,194	6	0·73	5	..	1	5	60,103	59	0·98	43	12	4	31
,, 15	16,129	16	0·99	13	1	2	13	7,751	10	1·29	7	2	1	5	59,252	122	2·05	88	19	5	58
,, 22	16,338	23	1·40	21	..	2	20	7,285	9	1·23	7	2	..	7	58,823	155	2·63	131	19	5	70
,, 29	16,265	24	1·47	18	3	2	17	7,084	10	1·41	9	1	..	6	..	164	..	140	19	5	69
July 6	16,216	21	1·29	16	4	1	15	7,098	19	2·67	18	..	1	9	70,784	202	2·85	171	23	8	65
,, 13	16,415	71	4·32	66	5	..	59	7,613	45	5·91	35	8	2	13	76,273	452	5·92	399	48	5	167
,, 20	16,264	45	2·76	45	..	..	29	7,557	24	3·17	22	2	..	6	76,212	542	7·11	494	49	1	162
,, 27	16,597	16	0·96	14	2	..	11	6,109	61	9·98	58	3	..	17	74,458	429	5·76	398	30	1	134
Aug. 3	18,502	46	2·48	42	1	1	34	7,842	83	10·58	75	8	..	20	80,282	680	8·47	627	46	7	179
,, 10	19,167	11	0·57	10	1	..	8	5,536	68	12·28	59	7	2	16	77,870	651	8·36	579	69	3	136
,, 17	18,776	38	2·02	30	..	8	18	5,296	58	10·95	43	12	3	9	75,743	780	10·29	641	117	22	152
,, 24	17,643	58	3·28	47	9	2	54	6,794	65	9·56	57	9	5	12	74,372	730	9·81	592	111	27	120
,, 31	17,210	35	2·03	32	2	1	17	5,854	63	10·76	47	15	1	15	73,492	694	9·44	579	95	20	156
Sept. 7	18,169	36	1·98	30	5	1	17	5,669	50	8·82	40	9	1	12	76,567	524	6·84	444	65	15	152
,, 14	18,161	44	2·42	32	6	6	15	12,560	45	3·58	33	12	..	10	83,524	556	6·65	437	96	19	144
,, 21	15,634	18	1·15	9	1	8	4	7,977	32	4·01	23	7	2	6	73,868	355	4·8	247	69	40	57
Totals	..	555	..	459	42	51	352	..	674	..	564	97	19	189	..	7,270	..	6,159	890	209	1,965

Diagnosis Station. The result was available on the same day, or next day. When the patient had to be evacuated at once the blood film accompanied him to the field ambulance, from where it was sent to the Diagnosis Station. The importance of this procedure was thoroughly recognized by all medical officers and systematically carried out, with the result that comparatively few cases of fever escaped the preliminary examination. The great majority of patients thus arrived at the field ambulance with the diagnosis already made. If not, a film was at once taken, and it was the function of each field ambulance to ensure that no case passed through unexamined. Further, patients with fever, whose blood had been found negative at the Malaria Diagnosis Station, were on admission to the casualty clearing stations again examined. Blood slides were submitted to the Military Laboratory, and if parasites were found the case was at once notified as malaria. This procedure also applied to such stationary and general hospitals as the patient might subsequently reach, so that malarial infections not already detected or developing in patients admitted for other ailments were recognized and reported. There was thus a complete chain of detective agencies all combining to produce the greatest possible degree of accuracy in diagnosis. The facilities given were sufficient to ensure the microscopic examination of practically every case. It was unnecessary to depend on clinical diagnosis, and column 6 in the table, which includes such cases as were diagnosed on clinical grounds alone, shows how little they bulked in the statistical returns.

The figures on which the tables are based include not only the cases diagnosed in the field, but also those subsequently detected at casualty clearing stations or in medical units further down the line of evacuation, in order that no case referable to the area be missed.

It will be seen, therefore, that the greatest care was taken to ensure that the recognition of all cases should depend on microscopic diagnosis, and that the compilation of the statistics should be as accurate as possible. There were, of course, many instances of infection so mild that the men did not report sick, and so escaped detection altogether or developed a typical attack later, e.g., during a march. Apart from those undetected or delayed infections, it is claimed that the figures given represent as accurately as such data can be obtained the total incidence of malaria among a given population over a given period.

The medical officers in charge of units were required to notify every case as it occurred, on a special form giving among other data the patient's name, unit, his recent movements and previous medical history. From these notifications spot maps were prepared and made for each unit. The tables given in this paper were constructed from these data, and it should be pointed out that the figures given are arranged in accordance with the weeks during which such notifications were received, and do not refer to dates of sickening. The average time elapsing between the latter and former dates was between five and seven days.

Column 7 in the tables is included for the purpose of showing the number of cases regarded by the medical officers as being recurrent infections. Three of the divisions, 3rd, 7th and 75th, were composite British and Indian formations, and the great majority of the men composing them had come from India, the two former via Mesopotamia, and one or two units had been in the campaign in East Africa. Certain British units, especially among Corps Troops, had been recently drafted from Salonica, and their medical officers possessed records of their previous history as regards malaria. These are quoted merely to show roughly the extent to which the force contained men liable to recurrent attacks of infection received in other countries, and the fact that a considerable reservoir existed from which mosquitoes became infected. They are included in the figures in column 2 and in the chart.

The incidence in the different formations of the corps shown in column 2 of the tables, is given also in the form of Chart 3.

The divisions occupied practically the same areas from April to September, with the exception of the 54th Division which was relieved by the 3rd (Lahore) Division during the last three days of June; it took over the Auja River line and remained in occupation up to the commencement of operations on September 19. The nature of the country and the boundaries of the divisional areas have already been described.

Incidence in the Various Formations.

54th Division.—This division, a British one, occupied the central portion of the area, between the 7th Division in the coastal sector and the 75th Division in the foothills east of the Plain of Sharon. Its front line on the left ran along the five miles of the River Auja from Ferrikhiyeh to Ras el Ain, and the brigade which lay along this stretch was exposed to infection from the river and its numerous tributaries. During the stay of the division in this area, comparatively little infection was traced to other sources, and the figures given practically represent the result of infection contracted by the brigade which was located along the river banks.

The 54th Division was relieved by the 3rd (Lahore) Division during the last three days of June, and proceeded to a healthy site near Ludd, about ten miles in the rear; during its subsequent history it was never much exposed to infection.

It will be observed (see Chart 3) that a moderate rise in incidence took place during the second week in June, but the maximum was not reached until after the relief took place and the brigade holding the Auja line had marched out, at the end of June, this increase being traceable almost solely to infection received in the vicinity of Ferrikhiyeh, Mill Race and Ras el Ain. It was during the period of the march to Ludd and the subsequent road-making operations on which the troops were employed during

July, that the greatest increase in cases occurred—an instance of what has often been noticed, that exertion and hard work influence the development of latent infections received during a period of quiescence in a malarious district.

The further experience of this division does not call for special remark. One brigade took over the front line round Mejdel Yaba, in the foothills, while another portion of the division was located in new territory at the southern extremity of the area. Such later cases as occurred were probably due to mosquitoes bred out in wells and cisterns, among units which occupied previously untenanted districts, where it had not previously been considered necessary to adopt anti-mosquito measures.

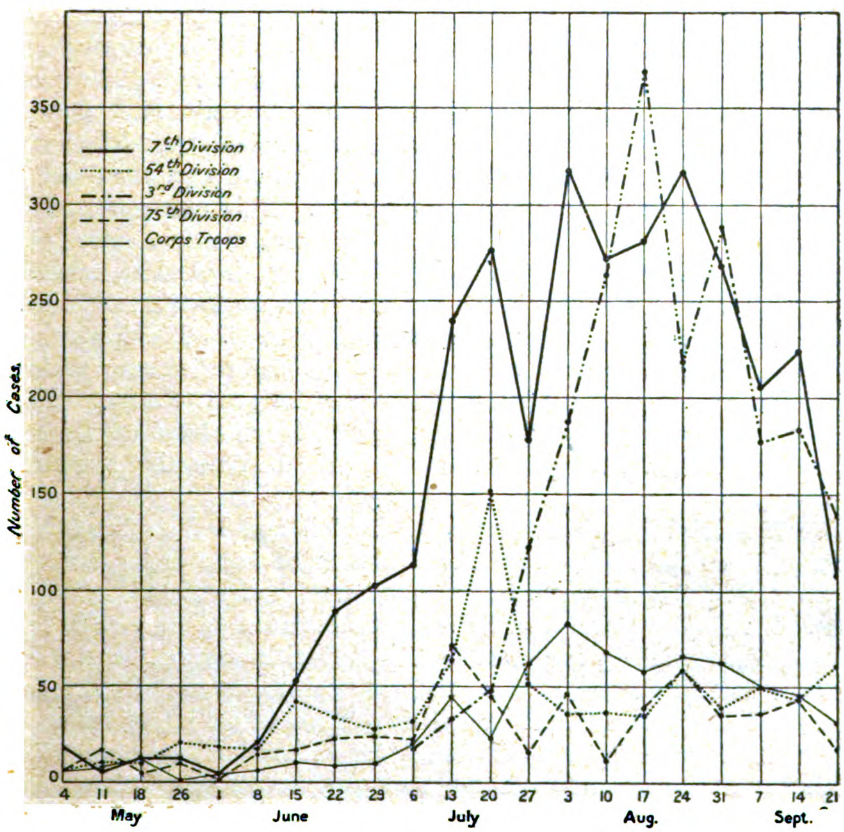
3rd (Lahore) Division.—This division on arrival from Mesopotamia relieved the 54th Division during the last three days of June. A rapid and steady increase in malaria began shortly afterwards (see Chart 3), reaching its maximum during the week ending 17th August, when 369 cases were notified. There was then an interrupted fall to the beginning of September, when 178 and 184 cases were notified during the weeks ending September 7 and 14 respectively, followed by a further fall to 138 cases during the subsequent week. The chart has not been carried beyond this date, as military operations on a large scale began on September 19, con-considerably affecting the work of the malaria diagnosis stations and interfering with the accuracy of the records.

By far the largest number of cases in this division occurred among units holding the Auja River line, in particular those located at Ferrikhiyeh, Mill Race, El Mirr and Ras el Ain. Indeed, the latter place was more dangerous than any other single spot in the whole area; as has been previously described, it was the most difficult to deal with and the last to come under control. On the 9th August the 3rd Division took over from the 7th Division the portion of the coastal sector between the Auja and the Hadrah road. This added about two miles to the front line held by the division, and included the area north-east and east of Ferrikhiyeh and the orange plantations on the right bank of the Wadi Ishkar, which had proved so difficult to canalize.

The troops of the 7th Division in this sector had suffered severely from malaria up to the time when the relief took place, and the relieving brigade of the 3rd Division soon began to develop cases. The effect of this move on the general incidence is shown in the increase which occurred in the notifications received during the week ending August 31. The rise figured in the chart against this date was partly due to the appearance of a large number of cases in the brigade which was detailed to hold the new sector of the line. The division thus from August 9 onward had the better part of two brigades in the front line, in occupation of what had been the most malarious zone in the whole area. Notwithstanding this, however, the number of cases in the division continued to decrease, even although a larger number of men were now exposed to infection.

A good deal of significance is attached to this curve, as we are of opinion that it shows decisively that the incidence of malaria was becoming steadily and rapidly reduced as the direct result of the vigorous anti-mosquito measures which had been applied to the Auja and its tributaries, as described in the preceding pages. There is no doubt that the work was bearing fruit. During August, anopheline larvæ were extremely difficult to find anywhere throughout this area; adults had become very

CHART 3.



much scarcer. Among individual units located along the river area between Ferrikhiyeh and Ras el Ain, a very substantial improvement in health was taking place during the third quarter of the year, when every indication from past experience of the natural history of malaria in Palestine pointed to the likelihood of a steady increase, reaching its maximum at the end of autumn. It can therefore be confidently argued that the lessening incidence among these troops was the direct result of the measures taken during the preceding months to eliminate the mosquito.

75th Division.—This division occupied the foothills to the east of the

plain of Sharon throughout the summer, and was never much exposed to infection. The two possible sources of mosquitoes existing in this area were comparatively easily controlled. These comprised the scattered wells and underground cisterns in and near the villages, which were either closed or oiled, and the two mountain streams in the Wadis Reiya and Zerka which were early and successfully canalized. A certain proportion of cases were, however, traceable to both these sources and also probably to a large pool close to the enemy's lines in front of the village of Rafat, which could not be reached.

The incidence in this division remained fairly uniform throughout the period (see Chart 3), and was pretty evenly distributed throughout the troops. Nothing at all approaching an epidemic occurred. The peaks in the curve during July and August were in the main part due to the influence of an Indian regiment (the 29th Punjabis), which had been heavily infected with malaria in East Africa, and had come on active service in Palestine at the end of April, 1918. This unit sent to hospital an irregular succession of cases during these two months. For instance, the rise shown against week ending July 13 contained thirty-seven cases from this unit alone, admitted after it had moved up to the front line. Up to the middle of August ninety cases had occurred. These were practically all chronic malaria patients known to the medical officer; their blood showed the presence of malarial parasites in the gamete stage. The unit was never exposed to infection in Palestine, likely to have caused such an incidence, while other troops in the same area had nothing like the same experience.

The 75th Division was a composite British and Indian formation, and the majority of the units composing it had come from India during 1917, and a considerable proportion of its personnel had suffered from malaria before. While any attempt to differentiate between primary and recurrent cases is subject to fallacy and must be accepted with reserve, it may be stated that over half of the cases (sixty-five per cent) occurring in the division were regarded by the medical officers as relapses of old infections as shown in Table II, column 7. An allowance for recurrences or imported cases to this extent is probably not far wrong when dealing with an average Indian division, and may be taken as representing the loss likely to arise from this cause on active service.

7th (Meerut) Division.—This division occupied the coastal sector between the River Auja and the sea during the whole of the summer. Cases began to occur in considerable numbers among its personnel about a month before any marked increase took place in the troops of the 54th Division located along the Auja River. These were at first confined entirely to units camped in the vicinity of the Bahret Katurieh Marsh. The influence of this marsh began to make itself felt during the first few days of June (see Chart 3), after which the incidence rapidly rose to its first maximum of 263 cases notified during the week ending July 20. Practically all these

early infections were related to the marsh. At the end of May and during the first few days of June *Anopheles maculipennis* began to spread over the surrounding country in large numbers; in camps on the hills near the marsh and on the sea shore at Arsuf as many as fifty could be counted in a single bivouac early in June. The marsh was not completely dry until July 10, and after this date a very large reduction in the number of mosquitoes was observed. The front line ran through the northern end of the marsh, so that it was impossible to move the troops to a safe distance without evacuating the whole area. The Infantry occupying the posts in the neighbourhood suffered severely, as did also the Royal Artillery, whose gun positions lay between the marsh and the sea. Apart from essential troops, all others were moved as far away as possible, and this doubtless accounted for the fall in incidence which took place during the week ending July 27. The subsequent rise which was maintained at a high level during the following weeks up to the third week in August was due to additional cases which began to make their appearance in three different areas: (1) in the trench system at the extreme left of the line where it reached the sea; (2) in the right sector between Hadrah Road and the River Auja; (3) among the troops camped round Khurbet Hadrah near Hadrah Dam, and round Sheikh Muannis north of the Auja, where considerable bodies of troops were located. The source of the mosquitoes in the first area was uncertain; there was certainly no possible breeding place in the area, after the Bahret Katurieh Marsh had been drained, yet mosquitoes in considerable numbers could always be found there up to the end of the season. This prevalence was possibly accounted for by the fact that the front line at this point was less than one and a half miles from the Birket Ramadan shown on the accompanying map, a large marsh on the course of the perennial Nahr El Falik, which lay well within the Turkish lines. Over 400 cases in all were reported as having been infected in this area. An equally large number of cases were traced to the neighbourhood of the Wadis Ishkar and Adas at the eastern extremity of the divisional area. *A. maculipennis* were prevalent, especially in Iskhar Wood, having no doubt bred out in these wadis before they could be successfully treated. There was also a large pool known to exist in No Man's Land opposite this sector which could not be reached. This area was responsible for nearly 400 cases in the 7th Division up to the time when the 3rd Division took it over. The third source was discovered to be due to breeding going on in the backwater of Hadrah Dam among the debris which had floated down and collected there from the clearing operations going on further upstream, and in the islets of weeds which appeared in the river itself between Hadrah Dam and the village of Jerisheh, as described in the section dealing with the River Auja. Nearly 700 cases of malaria occurred among troops in this area. After the third week in August the incidence began to diminish and steadily fell up to the time when the records ceased. The withdrawal of a brigade from the right sector on relief by the 3rd Division

on August 9 was no doubt a factor in this decline. On the other hand an epidemic of influenza which suddenly attacked the division on August 24, and spread rapidly, had the effect of bringing out latent infections and causing recurrent attacks of malaria.

Corps Troops.—This group was scattered throughout the various portions of the area; a large proportion, however, were grouped south of the Auja River on either side of the Nahr El Barideh and between the latter and the Tel Abu Zeitoun Marsh. The incidence in this group of units was probably due to the small amount of breeding which occurred in the lower reaches of the Barideh during July before it was canalized for the second time. Adults were never numerous, indeed it required careful and prolonged search to find any in the tents and bivouacs. It may be noted that, although one or two units remained within 1,500 yards of the Abu Zeitoun Marsh, only a very few cases occurred in them. There is no doubt that, had this marsh not received early and prompt treatment, a very large number would have occurred as in the case of the Bahret Katurieh.

VII.—A Note on the Effect of Temperature on the Breeding of Anophelines and the Incidence of Malaria.

Temperature records for a complete year from October 1917 to September 1918, taken at General Headquarters and referable to the coastal area of Palestine, are shown on Chart 2.

It will be observed that when anopheline breeding began in the open towards the end of April the mean weekly temperature was rising above 60° F., while the mean minimum temperature had not yet reached that figure. There is a fairly close association between the onset of malaria in the 7th Division during the early days of June and the mean minimum temperature, i.e., the epidemic did not commence until the latter temperature had reached 60° F. for about three weeks. It will also be noted, that both benign tertian and subtertian infections began to develop under similar temperature conditions, although it is generally stated that the parasite of the latter requires a distinctly higher temperature than that of the former for its development in the mosquito. As regards the winter outbreak of malaria described in the early part of this paper, anopheline mosquitoes (*A. bifurcatus*) were found to be breeding and sheltering in wells and to a small extent in open cisterns during December and January, when both the mean temperature and the mean minimum temperatures were well below 60° F., and, even during this period, were capable of transmitting subtertian as well as tertian infections. These mosquitoes were living in protected and sheltered conditions in wells varying in depth from twenty feet to sixty feet, where the temperature would be somewhat higher; it was, in fact, found that the temperature of the water and of the air in the wells during the day varied from 62° F. to 66° F., and from 58° F. to 63° F. respectively.

VIII.—Effect of the Anti-Malarial Operations.

The question naturally asked is "Were these extensive operations a success, and did they justify the labour and money expended on them?" To answer this question let us consider what would have happened if nothing had been done to render the area more healthy. The evil reputation and history of the country, experience of similar places in other countries, and the outbreaks of malaria which occurred among our troops in June, before the situation was completely controlled, all point to the same conclusion, namely, that the area was an intensely malarious one. It can hardly be doubted that practically every man condemned by military necessity to live among these marshes and to bivouac on the banks of these streams would have rapidly become infected with malaria. The places of such men would have been taken by others, who in their turn would have succumbed to the disease, and so on until the whole force would have dwindled away, and the crushing and final defeat of the Turks in September would have been an impossibility.

Instead of this the total number of cases which occurred in the force of roughly 70,000 men during the period of twenty-one weeks was only 7,271, of which 1,965 cases were relapses of old infections. Thus 5,306 fresh infections occurred, the greater part of which were caused by mosquitoes which hatched out before the rivers and marshes were brought under perfect control. It is a significant fact that the incidence of malaria was falling rapidly during September, that is, at a time when, under natural conditions, the number of cases would have been increasing to the maximum. This fact shows, in our opinion, that mosquito breeding had been kept well under control for at least a month, and that the work had met with a high degree of success. The cost, from a military standpoint, is hardly worth considering. £40,000 is a small sum when compared to the cost of even one day of the war, and if, as is claimed, its expenditure rendered possible the final defeat of the Turks and the occupation of Palestine and Syria, it was indeed a cheap investment. But, if we regard it from the point of view of a civilian community, the question of cost becomes one of primary importance. After the completion of the initial work in such a district, constant maintenance would be necessary to prevent breeding, and after the winter rains a great deal of the channeling and draining would have to be renewed each year. There is no doubt that such extensive anti-malaria measures are not within the power of any small agricultural community to carry out, but if the rich and fertile Valley of Sharon is ever to be developed into a prosperous and healthy agricultural country, the government of Palestine will be forced to adopt such measures as have been described in this paper.

It need hardly be said that all credit for the success of these operations is entirely due to those who tackled such problems on the spot, to the medical staff of each division, whose technical knowledge and experience in

dealing with malaria problems were of the utmost value, and to the Royal Engineers who gave their whole-hearted assistance and carried out every measure recommended with the utmost promptitude.

We are much indebted to Colonel C. E. P. Fowler, O.B.E., R.A.M.C., A.D.M.S., 4th Division; Colonel G. Browse, D.S.O., I.M.S., A.D.M.S., 3rd (Lahore) Division; Colonel W. H. Ogilvie, C.M.G., I.M.S., A.D.M.S., 7th (Meerut) Division; and Colonel G. A. T. Bray, D.S.O., R.A.M.C., A.D.M.S., 75th Division, not only for their unsparing efforts to make the scheme a success, but also for their reports and charts of which free use has been made in compiling this paper.

Our thanks are also due to Major E. E. Austen, D.S.O., whose technical experience and advice were of the greatest value throughout the operations.

SUMMARY.

(1) Adults of *A. bifurcatus* were found sheltering in wells in mid-winter, and when disturbed bit freely. Larvæ of this species were found at the same time in the wells.

(2) An outbreak of subtertian malaria occurred among troops billeted in close proximity to these wells in December and January.

(3) In open waters anopheline larvæ were not found until April 10, and breeding was not free until the end of May.

(4) Swarms of *A. maculipennis* appeared in the vicinity of the Bahret Katurieh at the beginning of June when breeding in the marsh was scanty, and a rapid increase of malaria followed. It seemed probable that these mosquitoes had hibernated in the tunnel and caves.

(5) As a result of extensive draining of marshes and canalization of rivers, larvæ and adult mosquitoes were reduced to a minimum by August, when, under natural conditions it might have been expected that their numbers would have been rising to a maximum.

(6) The incidence of malaria among the troops fell coincidently with the disappearance of anophelines.

(7) The total loss of men to the Army Corps from malaria was only about ten per cent of the strength during the twenty-one weeks under consideration, with the result that the troops were able during the autumn to engage in a most arduous campaign which ended in the annihilation of the Turkish Army and the cessation of hostilities.

CAPSULATE MUCOID FORMS OF PARATYPHOID AND DYSENTERY BACILLI.

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During the routine examination of the excreta of two chronic paratyphoid carriers, I have met with some curious capsulate bacilli which form large mucoid colonies on Endo's fuchsin-sulphite-agar, totally unlike those of *Bacillus paratyphosus* B, but which have proved, on further investigation, to be a variety of that organism.

I have also encountered similar organisms in a case of infection with *B. aertryck* due to eating pork pie, and in some convalescents from dysentery caused by bacilli of the mannite-fermenting group. I have not found them in typhoid, paratyphoid A, or in dysentery of the Shiga type; but this is, possibly, because such cases have been few in number and they may yet be found associated with these diseases; indeed, Professor Hewlett has suggested to me that all the members of the coli group may have this proteus-like power of disguising themselves, and he has drawn my attention to a paper by Cecil Revis, published in the *Centralblatt für Bacteriologie*, 26 Band, 1910.

Revis found that when a sample of soil contaminated with human fæces was first sterilized and then inoculated with a certain culture of *B. coli*, "very large, jelly-like, clear colonies," quite unlike ordinary *B. coli*, developed at the end of four months. These colonies gave the usual fermentations of *B. coli*, and "on microscopical examination the bacteria were seen to be embedded in a cementing substance." When they were subcultured it was found that "the typical form and the new type seem to be quite dynamic, passing readily from one to the other."

I have had no opportunity of conducting experiments on animals with the mucoid cultures which have been isolated, but I am publishing this account of them, without waiting until I can carry out inoculations, because it is important that they should be recognized; for, unless they are, those infections in which there are mucoids only, unassociated with colonies of typical form, will pass unrecognized.

In addition to Professor Hewlett I am indebted to Lieutenant-Colonel D. Harvey, Major Andrewes and Captain Inman for examining several of the cultures, to Dr. Doris MacKinnon and Miss Gertrude Long for drawings and charts, and to Dr. Alex. Hill for permission to make photographs at the Southampton University College.

The mucoids which have been found in paratyphoid and aertryck carriers differ, in many respects, from those isolated in cases of dysentery; it is better, therefore, to describe them separately.

I.—Paratyphoid Mucoids.

In the spring of 1917, the fæces of a number of soldiers from whom paratyphoid bacilli had been isolated during convalescence were examined daily, with the object of determining if the place of the pathogenic bacilli is taken by any special organism, or group of organisms, when the former disappear from the excreta. I hoped that if some particular organism frequently, or always, overgrew and crowded out the paratyphoid bacilli during convalescence, such an organism might be employed with benefit in the treatment of carriers; a forlorn hope, one must admit, when the gall-bladder is so often the stronghold of infection.

One of the patients undergoing examination, Pte. S., was a chronic paratyphoid carrier, who had been taken ill in the Eastern Mediterranean at the end of August, 1916. His excreta were examined many times, and when an emulsion of his fæces was plated direct on to Endo's fuchsin-sulphite-agar, from 50 to 100 per cent of the colonies which grew were composed of paratyphoid bacilli.

One hundred and sixteen samples of this patient's fæces had been examined (the 116th sample gave 100 per cent of paratyphoid colonies by direct plating), when suddenly, in the 117th, the percentage of paratyphoid colonies dropped down to ten and a new type of colony appeared on the plates. This new type consisted of the large, slimy, white, mucilaginous colonies to which I have given the name of "mucoids."

During the next eleven days the fæces were examined seven times, with the result that the average percentage of paratyphoid colonies was only eleven, while the mucoids were present in large numbers on each occasion; but on the twelfth day no mucoids were found on the plate, and the percentage of paratyphoid colonies rose once more to fifty. The mucoids were not found again in seven subsequent examinations, and the paratyphoid colonies were as numerous as ever.

The percentage of mucoids was recorded on three of the eight occasions on which they were found, and it will be noticed on reference to Chart 2 that the sum of the percentage of the mucoids and paratyphoids is approximately equal to the percentages of paratyphoid colonies usually seen when no mucoid organisms are present, so that the mucoids appear to have taken the place of the paratyphoid colonies.

The sudden and definite fall in the proportion of paratyphoid organisms which was coincident with the appearance of these large mucoid colonies led me to think that I had found what I was searching for, an organism which overgrew the paratyphoid germs and which might oust them from the body of the carrier.

Subcultures were made and the usual media were inoculated, when to my surprise the organism reacted in the same fashion as *B. paratyphosus* B. It was motile, did not liquefy gelatine, and did not form indol; acid and gas were produced in glucose, maltose, mannite, and dulcite. Milk and dextrin

were made first acid and then alkaline, while a bubble of gas was produced in the latter.

On investigation of the serological reactions, it was found that when first isolated, the organism was not agglutinated by a paratyphoid serum, but that it did absorb the agglutinins from it. When this strain of mucoids was retested eight months later, it agglutinated slowly and imperfectly in low dilutions. In the following table the agglutinations of Pte. S.'s mucoid culture was compared with the agglutinations of a type culture, Rowland, kindly supplied by Lieutenant-Colonel Harvey from the Royal Army Medical College. The serum employed was C.89 from the Lister Institute, with a stated titre of 1/6000.

CHART 1.

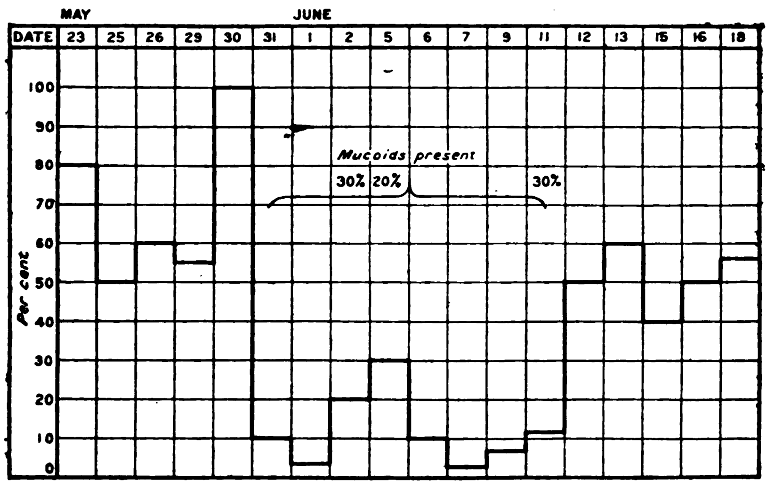

Chart showing percentage of ordinary paratyphoid colonies present on Endo plate and the fall in percentage when mucoids were present. The proportion of mucoids is given for those days on which it was recorded.

The agglutination tests in this case, and in connexion with the other organisms to be described in this article, were carried out with living emulsions in distilled water, prepared from agar slopes twenty-four hours old, in Wright's capillary pipettes. Except where otherwise stated, the results were read after two hours at 37° C.

AGGLUTINATIONS OF PTE. S.'S MUCOID WITH PARATYPHOID B SERUM C. 89 L.I.P.M. COMPARED WITH THE AGGLUTINATIONS OF A TYPE STRAIN ROWLANDS.

Dilution of serum	1/50	1/100	1/200	1/400	1/500	1/1,000	1/2,000	1/4,000	1/8,000	1/16,000	1/32,000
Type Rowlands ..	+	+	+	+	+	+	+	+	+	+	–
Pte. S.'s mucoid ..	+	+	+	+	–	–	–	–	–	–	–

Plus sign = agglutination.
Negative sign = no agglutination.

One day, when I wished to prepare a fresh culture from a single mucoid colony, I plated out some peptone-water which had been inoculated five days before; the result was a mixture of mucoids with ordinary paratyphoid colonies, so that, at first, I thought that I was working with a contaminated culture. Further investigation proved that this was not the case, but that the paratyphoid colonies had originated from the mucoid form, and that if a culture of the mucoid be inoculated into peptone-water and plated every day, there will be a few ordinary paratyphoid colonies on the plate made on the third day, and on the fifth they will be in the majority. That is to say, the mucoid colonies give rise to ordinary paratyphoid bacilli.

In order to test its purity an emulsion was made from an agar culture of the mucoid and plated on Endo's medium.

One of the mucoid colonies, from this plate, was shaken up in salt-solution and spread on an Endo plate. The result was mucoid colonies only.

One of these colonies was emulsified and another plate was spread. This process was repeated daily for twenty days and each day the result was mucoid colonies and mucoid colonies only.

Finally, an agar slope, inoculated from a mucoid colony on the twentieth plate, was emulsified in salt-solution and well shaken. It emulsified readily and the bacilli showed no tendency to stick together. When the emulsion had been counted by means of a Thoma hæmocytometer and dark-ground illumination, it was diluted in a series of large test-tubes, which measured eight inches by one inch, each dilution being shaken vigorously before the next was made. The dilution was carried to a point at which it was estimated that the bacterial content was such that there would be one bacillus in every two drops of a dropping-pipette.

Forty-eight plates were then inoculated by dropping one drop on to each of them and spreading it with the edge of a slide. On most of the plates there were several colonies or no growth at all, but on eight of them there was a single colony on each.

These eight colonies were emulsified in eight tubes of salt-solution and spread upon eight plates—the result being mucoid colonies only.

One colony from each plate was inoculated into ordinary one per cent peptone-water (reaction + 10) and every day an Endo plate was spread from each of these eight cultures.

On the plates which were made on the first two days there were only mucoid colonies.

On the third day there were between thirty and seventy per cent of paratyphoid colonies on seven of the plates, while on the eighth there were only mucoids, but on the fourth day there were fifty per cent of paratyphoid colonies on the plate spread from this eighth tube.

On the sixth day there were only paratyphoid colonies on three of the plates and none of the other five showed more than ten per cent of mucoids. After the sixth day the proportion of mucoids increased slightly and

declined again, about the ninth day, as shown in the accompanying chart. On the fifteenth day there were still a few mucoid organisms present.

The only way in which these paratyphoid organisms, derived from mucoids, differ from typical paratyphoid bacilli is that (*a*) the colonies on solid media are as a rule more granular; (*b*) there are more long "involution forms" present than usual. Subcultures from these derived colonies behave, in every other respect, like ordinary paratyphoid organisms; they are agglutinated to the full titre of an immune serum and they absorb the specific agglutinins from it; they were, moreover, agglutinated by the patient's own serum at the same dilution as the typical paratyphoid bacilli which had been isolated from his fæces.

CHART 2.

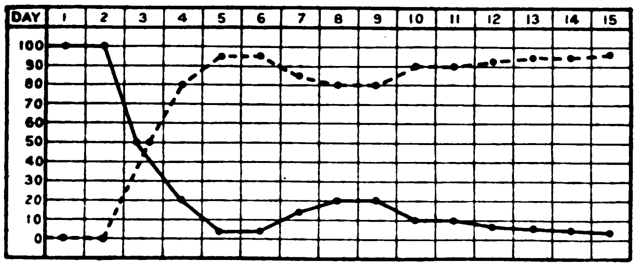

Chart showing the relative proportions of mucoid and ordinary paratyphoid bacilli in the tubes from the first to the fifteenth day. The unbroken line denotes the mucoids. The broken line denotes the ordinary paratyphoid organisms.

The mucoid colonies have about twice the diameter of an ordinary paratyphoid colony and after repeated subculture on successive days they become yet larger and attain a diameter of more than one centimetre in twenty-four hours. They are dome-shaped, circular in outline, with a regular margin, and a mucoid appearance absolutely unlike a paratyphoid colony. When examined by transmitted light, they are very translucent and have something the appearance of frosted glass.

A fresh culture on an agar slope is thick and slimy like mucus, but, after a few days, the sliminess disappears, except near the top of the tube and, on replating, some ordinary paratyphoid organisms derived from the mucoids are found amongst them. If a culture on agar be left for several weeks, and then plated, the resulting growth will consist almost entirely of non-mucoid, paratyphoid colonies and a few, minute, ghostly colonies mingled with them, which have a ground-glass appearance. If the latter be subcultured several times, they will give rise to the luxuriant, large mucoids once more.

Though the ordinary form of paratyphoid bacilli can always be obtained from the mucoids by subculturing for a few days, I have never yet succeeded in reversing the metamorphosis and obtaining mucoids from

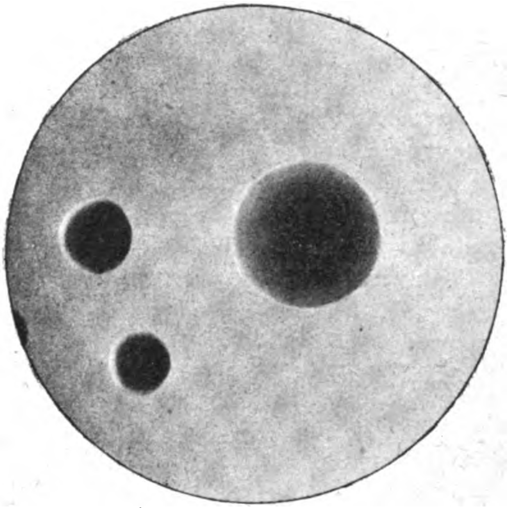

Fig 1.—Photograph of part of Endo plate, spread with a mixture of the mucoids, isolated from Pte. S.'s fæces, and typical *B. paratyphosus* B. The large colony is a mucoid; the two small colonies consist of typical *B. paratyphosus* B, derived from Pte. S.'s mucoid.

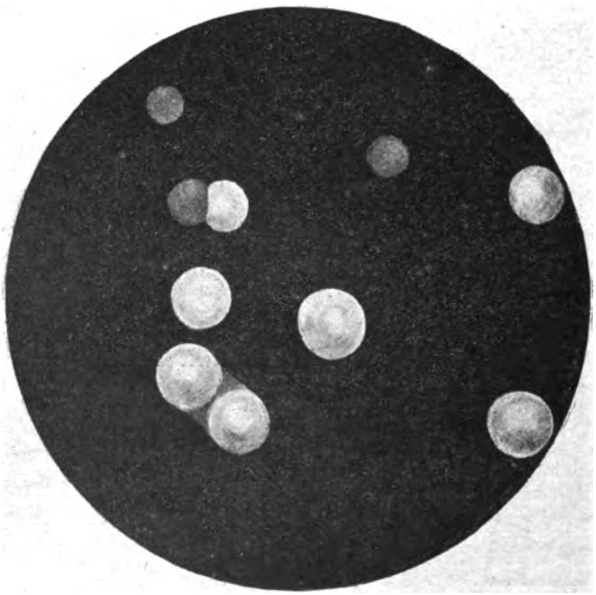

Fig. 2.—Sketch of five-day peptone culture of mucoid isolated from fæces of Pte. S., plated on Endo's medium. The large colonies represent the mucoids, the small colonies consist of paratyphoid organisms derived from them.

the ordinary form. Cecil Revis, it will be remembered, found that his "jelly-like" *coli* colonies passed readily from one form to the other.

When bacilli from mucoid colonies, twenty-four hours old, are examined under the microscope it is found that, while many of the bacilli measure from 1·5 to 2·5 microns, there is a large number of small coccoid forms, 0·75 to 1 micron in diameter. The general appearance of a film made from one of the paratyphoid colonies derived from the mucoids is very different, and it is impossible to give a correct impression of that difference by a bald statement of measurements. These derived bacilli are, for the most part, larger; the small coccoid bacilli, so numerous in mucoid films, are rare, and very long "involution-forms," which measure from 12 to 45 and even 100 microns in length, are the most striking feature.

When a culture of the mucoid form, in peptone-water, is examined by the dark-ground method, the number of small cocco-bacilli at once catches the eye, and the rapidity with which these coccoid forms travel is very striking.

If a portion of a mucoid colony, which has grown for twenty-four hours, be placed on a glass slide, spread with the edge of a second slide and stained with dilute carbol-fuchsin, it is seen that the individual bacilli do not lie close, side by side, but are separated from each other by a matrix in which they are embedded. The spreading of the slide draws out the matrix so that the bacilli lie with their long axes parallel to each other, deeply stained in a light coloured matrix, giving the film the appearance of a section of fibrous-tissue. If such a film be compared with one made in a similar fashion from the derived paratyphoid colonies, it will be seen that in the latter preparation the bacilli lie close together and are not separated from one another by any matrix.

When films of the mucoids and of the derived colonies are stained by Benian's "relief stain" (Benian, T. H. C., *British Medical Journal*, November 25, 1916) the two can be distinguished at a glance. The picture is quite different from that given by ordinary staining methods; there the bacilli in mucoid cultures are smaller than those in the derived; here, on the contrary, the silhouettes of the mucoid organisms are much the larger. The explanation of this is that they have capsules, while the paratyphoid bacilli in the derived colonies have none.

In films made from the mucoids the faint outlines of the bacilli can be distinguished lying within thick capsules, and there are many round, coccoid forms about three microns in diameter. The capsules cannot be stained by ordinary means, such as Welch's method, and it is possible that they are not firm envelopes, but are derived from the mucoid matrix in which the bacilli are embedded and envelop them as drops of dew envelop particles of dust.

There is yet another point of difference between the films made from the mucoids and those prepared from the derived paratyphoid colonies; in the latter the background of Congo-red is homogeneous, but in the mucoid film

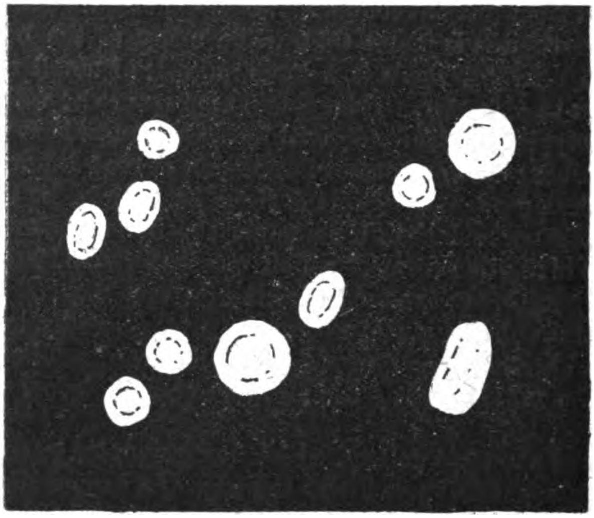

FIG. 3.—Drawing of silhouettes of mucoid organisms in case of Pte. S. (Benian's stain) × 2,000.

FIG. 4.—Drawing of silhouettes of paratyphoid bacilli derived from mucoids (Benian's stain). × 2,000.

it is traversed in all directions by an irregular reticulum composed of a deposit of small granules, which appears to be derived from the mucilaginous matrix. This deposit is not shown in the drawing, fig. 3.

The chief points of difference between the mucoid organisms and typical *B. paratyphosus* B are as follows:—

(1) In their size and appearance the mucoid colonies bear no resemblance to those of *B. paratyphosus* B.

(2) The mucoid bacilli are capsulated; many of the individuals in a young culture are smaller than ordinary paratyphoid bacilli and are round like cocci.

(3) The mucoid cultures were not agglutinated by a paratyphoid immune serum when first isolated, and after subculture, for a period of several months, they are agglutinated in low dilutions only.

The evidence in favour of classifying these mucoids as a form of *B. paratyphosus* B is overwhelming and may be summed up as follows:—

(1) The organisms are motile, Gram-negative, do not liquefy gelatine or produce indol, and their fermentation reactions are the same as those of *B. paratyphosus* B.

(2) The specific agglutinins for *B. paratyphosus* B are removed from an immune serum by absorption with the mucoids isolated from Pte. S.'s excreta.

(3) When peptone-water or other media are inoculated with a mucoid colony and then incubated for several days, there appear in the medium bacilli with the typical characteristics of ordinary *B. paratyphosus* B.

This is conclusive evidence that Pte. S.'s mucoid is a form of *B. paratyphosus* B.

The mucoid organisms disappeared from the excreta of Pte. S. on June 11, 1917, and, shortly afterwards, he was transferred to another hospital. From that time, until October 6, only six carriers of paratyphoid bacilli were admitted to this hospital. None of them was a chronic carrier and no mucoids were found in their excreta; but on October 6, Pte. C., a chronic carrier of *B. paratyphosus* B, was sent here from France. He had been taken ill, September 1, 1917, and had suffered from a severe attack with high fever and with hæmorrhage from the bowels. He was an inoculated man and the record in his pay-book showed that he had received two injections, by the T.A.B. 2 method, a year and a half before his illness.

When the first plate, prepared from his fæces, came to be examined, it was recognized at once that there was a large number of mucoids present, which called to mind those found four months before in Pte. S. In the case of Pte. C. the mucoids did not disappear while the patient remained in this hospital, and in fifty-nine examinations made while he was here they were found forty-seven times. Ordinary *B. paratyphosus* B was always present as well, and, as a rule, eighty per cent of the colonies on an Endo plate, spread with an emulsion of the fæces, consisted of mucoids and

typical paratyphoid colonies; sometimes the mucoids were more numerous, sometimes the typical paratyphoids.

The mucoid organisms which were found in Pte. C.'s case resembled those of Pte. S. in every way, but with one important exception; that is, they do not remove completely the specific paratyphoid agglutinins from an immune serum saturated with them.

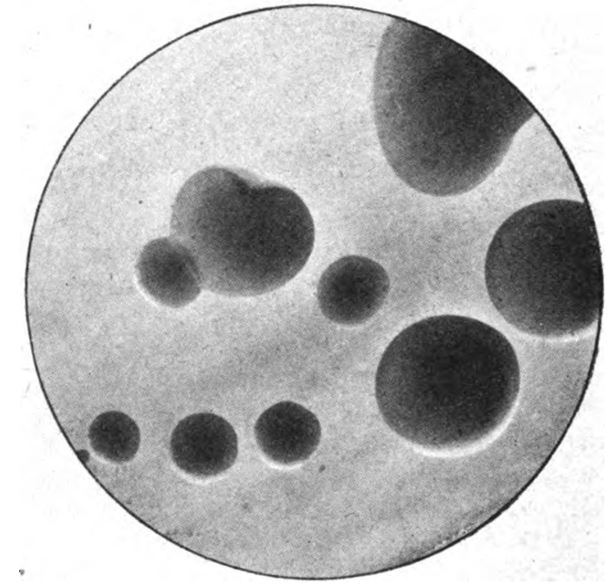

FIG. 5.—Photograph of part of an Endo plate spread with an emulsion of the fæces of Pte. C. The large colonies are the mucoids and the smaller are the typical *B. paratyyhosus* B. × 5.

The saturation test was carried out in the following manner:—

Ten agar slopes were inoculated thickly with the mucoid and incubated for twenty-four hours. The growth on five of them was emulsified in two cubic centimetres of salt-solution and added to 0·4 cubic centimetre of paratyphoid B serum, C. 89 (Lister Institute), which is diluted 1/25 and has a stated titre of 1/6,000. The mixture was incubated for four hours at 37° C.; it was then centrifuged and the supernatant, dilute serum removed with a pipette. The five agar slopes which remained were emulsified in two cubic centimetres of salt-solution and added to two cubic centimetres of the supernatant serum from the first centrifugalization. The mixture was incubated for three hours and then centrifuged. The agglutinating power of the serum after the saturation and centrifuging described above was compared with that of the same serum before absorption with the mucoid, by testing it against a type strain, "Rowlands," of *B. paratyphosus* B, and the result was as follows:—

AGGLUTINATION OF TYPE STRAIN *B. paratyphosus* B WITH PARATYPHOID SERUM C 89 BEFORE AND AFTER ABSORPTION WITH PTE. C.'S MUCOID.

Dilution of serum	1/600	1/1,200	1/2,400	1/4,800	1/9,600	1/19,200	1/38,400
Serum before saturation with Pte. C.'s mucoid	+	+	+	+	+	+ trace	−
Serum after saturation with Pte. C.'s mucoid	+	+	+	+	+	+ trace	−

Positive sign = agglutination. Negative sign = no agglutination.

It is clear then, that under the conditions of this experiment the mucoid organisms isolated from Pte. C. do not absorb the specific agglutinins from a paratyphoid serum.

As it was suggested to me that this method was too violent, the test was repeated by employing gradual saturation as follows :—

Agar slopes were inoculated with the mucoid, and incubated for twenty-four hours. The growth on three of them was emulsified in normal salt-solution, and four drops of undiluted paratyphoid serum, which had a stated titre of 1/6,000 (C. 89 Lister Institute), were mixed with seventy-six drops of this emulsion (so that the resulting dilution was 1/20, and the mixture incubated for four hours. This quantity of emulsion was sufficient to absorb all the agglutinins for the same bacilli, i.e., Pte. C.'s mucoid organism, as shown in the following table :—

AGGLUTINATION OF PTE. C.'S MUCOID BY SERUM C. 89 BEFORE AND AFTER ABSORPTION WITH THREE TUBES OF THE SAME ORGANISM.

Dilution of serum	1/40	1/80	1/160	1/320	1/640	1/1,280
Serum before absorption ..	+	+	+	+	+ (trace)	−
Serum after absorption ..	−	−	−	−	−	−

It was not sufficient, however, to remove the agglutinins for the type strain of *B. paratyphosus B.*, "Rowland's."

AGGLUTINATION OF TYPE STRAIN "ROWLANDS" BY SERUM C. 89 BEFORE AND AFTER ABSORPTION WITH THREE TUBES OF PTE. C.'S MUCOID.

Dilution of serum	1/400	1/800	1/1,600	1/3,200	1/6,400	1/12,800	1/25,600
Serum before absorption ..	+	+	+	+	+	+	+ trace
Serum after absorption ..	+	+	+	+	+	+ trace	−

Thirty drops of the centrifuged serum, which had been partially absorbed as described above, were mixed with sixty drops of an emulsion made from two more agar slopes of the mucoid (so that the dilution of the

serum was now 1/60), incubated for four hours and again tested with the type strain "Rowlands"; but still the agglutinins were not removed.

AGGLUTINATION OF TYPE STRAIN "ROWLANDS" WITH PARATYPHOID SERUM C. 89 BEFORE AND AFTER ABSORPTION WITH 3 + 2 TUBES OF PTE. C's MUCOID.

Dilution of serum	1/360	1/720	1/1,440	1/2,880	1/5,760	1/11,520	1/23,040
Serum before absorption ..	+	+	+	+	+	+	+
Serum after absorption ..	+	+	+	+	+	+ trace	–

Sixteen drops of the serum, which had been absorbed by 3+2 tubes, were mixed with sixty-four drops of the emulsion made from two agar slopes of the mucoid (dilution of serum was now 1/300) and, after twelve hours' incubation, once more tested with the type strain of *B. paratyphosus* B. Agglutinins were still present, but the amount was diminished.

AGGLUTINATION OF TYPE STRAIN "ROWLANDS" WITH PARATYPHOID SERUM C. 89 BEFORE AND AFTER ABSORPTION WITH 3 + 2 + 2 TUBES OF PTE. C.'s MUCOID.

Dilution of serum	1/600	1/1,200	1/2,400	1/4,800	1/9,600	1/19,200	1/38,000
Serum before absorption.. ..	+	+	+	+	+	+	–
Serum after absorption	+	+	+	–	–	–	–

Thirty drops of the serum which had been absorbed by 3+2+2 tubes, were mixed with thirty drops of emulsion from one agar slope of the mucoid and, after twelve hours' incubation, it was tested once more, but the agglutinins were not removed completely.

AGGLUTINATION OF TYPE STRAIN "ROWLANDS" BY SERUM C. 89 BEFORE AND AFTER ABSORPTION WITH 3 + 2 + 2 + 1 TUBES OF PTE. C.'s MUCOID.

Dilution of serum	1/1,200	1/2,400	1/4,800	1/9,600	1/19,200	1/38,400
Serum before absorption	+	+	+	+	+	–
Serum after absorption	+	–	–	–	–	–

These results form a great contrast to those obtained with Pte. S.'s mucoid where the paratyphoid agglutinins were completely absorbed by the addition of the washings of five agar slopes.

If a tube of peptone water or other medium be inoculated with a culture of Pte. C.'s mucoid and incubated for several days, the result is the same as with the mucoid which was isolated from Pte. S., the first case described; that is to say, the mucoids give rise to ordinary para-

typhoid bacilli which are not only agglutinated to full titre by a paratyphoid serum, but also remove the specific agglutinins from it by absorption.

The saturation tests for these derived organisms were carried out in the same way as those in connexion with the mucoids from which they were derived. Four drops of the paratyphoid agglutinating serum C. 89 were mixed with seventy-six drops of a bacterial emulsion made from three agar slopes, incubated for four hours and then tested with the type strain of *B. paratyphosus* B. "Rowlands," with the following result:—

AGGLUTINATION OF TYPE STRAIN "ROWLANDS" BY SERUM C. 89 BEFORE AND AFTER ABSORPTION WITH THREE TUBES OF THE ORGANISM DERIVED FROM PTE. C.'S MUCOID.

Dilution of serum	1/400	1/800	1/1,600	1/3,200	1/6,400	1/12,800	1/25,600
Serum before absorption.. ..	+	+	+	+	+	+	trace +
Serum after absorption	+	+	+	+	–	–	–

Thirty drops of the centrifuged serum, partially absorbed as shown above, were mixed with sixty drops of an emulsion made from two more agar slopes of the organism derived from Pte. C.'s mucoid and incubated for four hours, with the result that the specific agglutinins were removed by absorption.

AGGLUTINATION OF TYPE STRAIN "ROWLANDS" BY SERUM C. 89 BEFORE AND AFTER ABSORPTION WITH 3 + 2 TUBES OF ORGANISM DERIVED FROM PTE. C.'S MUCOID.

Dilution of serum	1/360	1/720	1/1,440	1/2,880	1/5,760	1/11,520	1/23,040
Serum before absorption.. ..	+	+	+	+	+	+	+
Serum after absorption	–	–	–	–	–	–	–

A very glutinous variety of mucoid was isolated on one occasion from the fæces of the second patient, Pte. C. The colonies formed by this glutinous type resemble the mucoids in general appearance but they are smaller and so very glutinous that if one touches them lightly with a platinum needle, and then withdraws it, a long sticky thread stretches between the colony and the point of the needle, which may be withdrawn four or five centimetres before the thread breaks. These glutinous colonies have the same cultural and serological reactions as the mucoid form and differ from them only in the two physical attributes first mentioned, their small size and their stickiness. One must conclude therefore that the glutinous organisms are, like the mucoids, a form of *B. paratyphosus* B.

It has been mentioned already that though ordinary *B. paratyphosus* B. is constantly obtained from the mucoids, by subculture for several days, the process cannot be reversed in any of the media which were used, and

the same is true of the glutinous type; both the mucoids and glutinoids are precursors of the ordinary form under the conditions employed.

II.—Aertryck Mucoids.

Mucoid organisms have also been isolated from a patient, Pte. W., who was suffering from an acute infection with *B. aertryck* of the "mutton" type, which was ascribed to the consumption of an infected pork pie. Typical aertryck bacilli were isclated five times from this man's fæces, and once from his urine.

Mucoid bacilli were recovered from the fæces on one occasion only, at the beginning of the third week. This mucoid organism is motile, Gram-negative, does not liquefy gelatine or produce indol. It turns milk acid in twelve hours, and alkaline after four days. Its fermentation reactions in lactose, saccharose, glucose, maltose, mannite, dextrin, and dulcite, are identical with those of *B. aertryck*.

The serological reactions resemble those of the paratyphoid mucoid isolated from Pte. C.; when first isolated emulsions of the organisms were not agglutinated by an aertryck serum, nor did they absorb the specific agglutinins from it, but, as is the case with the paratyphoid mucoids, when a culture in peptone water, which has been growing for a few days, is plated on Endo's medium, there are colonies of ordinary aertryck bacilli mingled with the mucoid colonies on the plate. The bacilli which compose the colonies derived from the mucoids behave in every way like typical *B. aertryck* of the mutton type, they are agglutinated to full titre by an aertryck serum (C. 38 Lister Institute), and they absorb the specific agglutinins both for the type strain ("Mutton" Lister Institute), and for the ordinary *B. aertryck*, which was isolated from Pte. W.'s excreta at the beginning of his illness.

One must conclude, therefore, that there is a mucoid form of *B. aertryck* as well as a mucoid form of *B. paratyphosus* B.

III.—Organisms of the Mucoid Type in Dysentery.

Mucoid colonies have been found in four carriers of *B. dysenteriæ* (mannite-fermenting) and in one convalescent who had suffered from dysentery, but from whose excreta dysentery bacilli were never isolated.

These mucoids differ in many respects from those found in paratyphoid infections. On an Endo plate spread with an emulsion of the fæces, and incubated for twenty-four hours, the mucoid colonies are about twice the size of the usual dysentery colony, but on plates made from subcultures they are smaller, and reduced to little yellow droplets, which, in a twenty-four-hour culture, adhere to a platinum loop, and can be removed bodily from the surface of the medium without leaving a trace behind. In older cultures, on the contrary, they become very adherent, and are removed with difficulty. Subcultures on agar slopes are not slimy like the paratyphoid mucoids, but hard, rough, and tenacious, with a yellowish colour.

These mucoids quickly give rise to non-mucoid forms; if a subculture made from a single colony be incubated for twenty-four hours, and then plated out, it will be found to contain many non-mucoid organisms. If a recent culture be examined under the microscope, it is seen to consist of small non-capsulate bacilli mixed with chains of bacilli embedded in capsules; one long capsule may contain a number of bacilli lying end to end, so that they look at first sight like the hyphæ of some mould.

Nearly all the bacilli are non-motile, but in three cases (Rfm. W., Pte. T., and Pte. S.) there are a few very minute bacilli, almost cocci, which are extraordinarily active, and dash across the field of vision with amazing speed.

The following table shows the cultural reactions of these five mucoids isolated from dysentery convalescents. The reactions of the non-mucoid bacilli derived from them were the same.

TABLE OF CULTURAL REACTIONS OF MUCOIDS ISOLATED FROM DYSENTERY CONVALESCENTS.

	Lactose	Saccharose	Glucose	Maltose	Mannite	Dextrine	Dulcite	Milk	Motility	Indol	Gelatin
Gnr. H...	—	—	A	A	A	—	—	A-K^6	—	—	—
A. B. L.	—	A	A	A	A	—	—	A clot[8]	—	—	—
Rfm.M...	—	A	A	A	A	A-K^3	—	A-K^3	A few motile	—	—
Pte. T. ..	—	A	A	A	A	A-K^3	—	A-K^5	A few motile	—	—
Pte. S. ..	—	A	A	—	A	—	—	A	A few motile	—	—

A = Acid. K = Alkaline. K^3 = Alkaline on third day.
Minus sign = No change, non-motile, no liquefaction.

The serological reactions of the Flexner-like organisms, derived from the mucoids of dysentery convalescents, were tested with agglutinating serum C. 137, which had a stated titre of 1/1,500 both for *B. dysenteriæ* Y and *B. dysenteriæ Flexner*, and had been prepared at the Lister Institute by the use of two strains as antigens, namely, "Hiss and Russell Y" and "Ledingham Y." This serum gave the following agglutinations with the type cultures in this laboratory :—

B. dysenteriæ "Y" (Hiss and Russell)	.. ..	1/1,500
,, ,, (Ledingham)	.. ..	1/3,000
,, ,, (Elstree)	.. .. ..	1/800

In the table below, the end titre of agglutination is given with serum C. 137, both for the cultures derived from the mucoids and for the ordinary Flexner-Y type organisms recovered from the excreta of the same patients.

The mucoid cultures, on agar, contain many non-mucoid bacilli after twenty-four hours' growth, as has been mentioned before, and emulsions of these mucoids are agglutinated imperfectly, and in low dilutions, by immune serum C. 137. The cultures derived from these mucoids by sub-

culture, are all agglutinated by this serum, but, as shown in the table, not all are agglutinated to full titre.

TABLE SHOWING AGGLUTINATIONS WITH SERUM C. 137 OF CULTURES DERIVED FROM MUCOIDS AND OF THE CULTURES OF ORDINARY "FLEXNER Y" TYPE RECOVERED FROM THE SAME PATIENTS.

Name	Culture derived from mucoid	Typical *B. dysenteriæ* isolated from same patient
Gunner H.	1/1,000	1/1,500
A. B. L.	1/1,600	None isolated
Rfmn. M.	1/600	1/2,500
Pte. T.	1/1,200	1/2,000
Pte. S.	1/600	1/2,000

Saturation experiments were conducted with these five mucoids and the corresponding non-mucoid strains which had been derived from them by subculture. Serum C. 137 (Lister Institute) and cultures of its antigens, "Hiss and Russell Y" and "Ledingham Y," were employed in one set of experiments, and Flexner serum C. 94 (Lister Institute), with its antigen "Flexner Elstree" in another. The result was that none of the ten strains absorbed the specific agglutinins from either serum.

Further tests were carried out to determine if the agglutinins for the typical dysentery bacilli which had been isolated previously from the same patients were absorbed from the above sera by saturation with the mucoids and by the strains derived from them. The results were again negative. It is very doubtful, therefore, if the mucoids found in the excreta of these patients are true dysentery bacilli.

SUMMARY AND CONCLUSION.

(*A*) *Paratyphoid and Aertryck Mucoids.*

(1) Capsulate bacilli which form slimy, mucoid colonies, larger than paratyphoid colonies, and which I have called mucoids, have been isolated from the excreta of two chronic carriers of *B. paratyphosus* B, and one case of acute infection with *B. aertryck*.

(2) These mucoids are motile, Gram-negative, do not produce indol, form acid and then alkali in milk, and have the same fermentation reactions as *B. paratyphosus* B.

(3) The mucoids are agglutinated in low dilutions only, by paratyphoid immune sera.

(4) The mucoids, isolated from one of the two paratyphoid carriers, absorb the specific agglutinins from a paratyphoid serum, in the other case they do so imperfectly.

(5) The mucoids isolated from the patient who was suffering from an infection with *B. aertryck* did not absorb the agglutinins from an aertryck serum of the same type.

(6) After a few days' subculture in peptone-water, bacilli resembling ordinary paratyphoid organisms appear amongst the mucoids; these bacilli are derived from the mucoids.

(7) The organisms derived from the paratyphoid mucoids are agglutinated to full titre by a paratyphoid serum, and the organisms derived from the aertryck mucoids are agglutinated to full titre by an aertryck serum.

(8) The derived organisms absorb the specific agglutinins from paratyphoid and aertryck sera respectively.

(9) In carriers of *B. paratyphosus* B and in infections with *B. aertryck*, certain mucoid organisms may be met with which are precursors of ordinary *B. paratyphosus* B and *B. aertryck* respectively.

(*B*) *Dysentery Mucoids.*

(1) Mucoid organisms have been isolated from four dysentery carriers, and from one dysentery convalescent who was not a carrier.

(2) After subculture of these mucoids in peptone-water, bacilli which resemble ordinary dysentery bacilli appear amongst the mucoids. These bacilli are derived from the mucoids.

(3) These derived bacilli are agglutinated by immune sera of the Flexner-Y type, but they do not absorb the specific agglutinins for the homologous cultures or for the typical dysentery bacilli isolated from the same patients.

(4) Neither the mucoids, isolated from these dysentery convalescents, nor the non-mucoid strains derived from them, have been shown to be dysentery bacilli.

SPHENOIDAL EMPYEMA AND EPIDEMIC CEREBROSPINAL FEVER.[1]

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THERE are four varieties of the clinical course taken by cerebrospinal fever:—

Firstly, there is the case which, commencing as an acute illness, may then go on to recovery or may result in death.

There is, secondly, the type of case that, after having shown considerable improvement from the acute stage, suffers from a recrudescence, both in general symptoms and in the condition of the cerebrospinal fluid. This usually occurs from the fifth to twelfth day, and may subsequently lead to recovery or death.

Thirdly, there is the type of case that, after convalescence from the acute stage, still retains a tendency to suffer from malaise, headaches and vomiting, which gradually become more pronounced. The patient becomes extremely emaciated and death occurs from hydrocephalus.

Fourthly, there is the case that, having entirely recovered from the preliminary attack, months later has a relapse which may prove fatal.

Thirty-four post-mortems were made in the Netley district between 1915 and 1919, on cases of cerebrospinal fever, dying as a result of one of these four types of the disease. These are all grouped in the ensuing table under three of these types:—

(*A*) Those dying during the acute illness—twenty-one cases.

(*B*) Those dying during a recrudescence—six cases.

(*C*) Those dying from hydrocephalus during convalescence—seven cases.

One case only (22 Mn.) died as a result of a relapse occurring months after the preliminary attack, but as he suffered from an apparently typical attack of the disease with a recrudescence he is grouped under heading B for convenience.

Of these thirty-four deaths, only eleven occurred within the first week of illness. In this observation we differ from Rolleston [1] who states that "more than half the fatal cases occur during the first week of the disease." A possible explanation of this difference is that at Netley we were fortunately able to insist that every case in which the least suspicion of cerebrospinal fever was entertained should be immediately admitted to the isolation hospital. On admission lumbar puncture was performed as a routine

[1] **Read at the Pathological Section of the Royal Society of Medicine, on November 4, 1919.**

within a few minutes of arrival, antimeningococcic serum being administered there and then to cases showing turbid cerebrospinal fluid. A bacteriological diagnosis was only waited for when there was middle ear disease or a head wound. This very early administration of serum, often within an hour or two only of the suspicion of cerebrospinal fever being present, probably saved many cases who would otherwise have died during the first week.

A.—ACUTE CASES.

Name	Number of days from onset to death	C.S.F. type	Nasal type	Crib. eth-moid	Sphenoidal sinus		Sphenoidal bone		Pituitary fossa	Middle ear
					Em-pyema	Meningo-cocci	Em-pyema	Meningo-cocci		
(1) Sh. ..	1	N.O.	N.O.	Nil	Serous effusion	Not found	Nil	—	Inflam.	Nil
(2) Wh...	1	II	N.O.	,,	Yes	Not found	Yes	Not found	,,	,,
(3) Cl. ..	2	II	N.O.	,,	,,	II	Nil	—	,,	,,
(4) La. ..	2	II	II	,,	,,	II	,,	—	,,	,,
(5) Ha...	3	Pos.	Pos.	,,	,,	Pos.	Yes	Pos.	,,	,,
(6) Me. ..	3	Pos.	Pos.	,,	,,	Not found	Nil	—	,,	,,
(7) Wa...	3	II	N.O.	,,	Serous effusion	II	,,	—	,,	,,
(8) Es. ..	3	I	I	,,	Yes	Meningo-cocci	Yes	Not found	,,	Congestion of bone
(9) Va. ..	4	I	N.O.	,,	,,	Meningo-cocci	Nil	—	,,	Pus in ear
(10) Hr. ..	5	Pos.	N.O.	,,	,,	Not found	,,	—	,,	Nil
(11) Ch. ..	7	,,	N.O.	,,	,,	Not found	,,	—	,,	,,
(12) An. ..	9	I	I	,,	,,	I	,,	—	,,	,,
(13) Ho. ..	10	Pos.	Pos.	,,	,,	Not found	Yes	Not found	,,	,,
(14) Po. ..	11	I	N.O.	,,	,,	Not found	Nil	—	,,	,,
(15) Cr. ..	16	II	II	,,	,,	Meningo-cocci	Yes	II	,,	,,
(16) He. ..	19	Pos.	N.O.	,,	,,	Meningo-cocci	Nil	—	,,	,,
(17) Su. ..	27	III	N.O.	,,	Nil	—	,,	—	,,	,,
(18) Hu...	34	Pos.	Pos.	,,	Yes	Pos.	Yes	Pos.	,,	,,
(19) Ti. ..	40	Pos.	N.O.	,,	,,	Not found	Nil	—	,,	,,
(20) Th. ..	47	Pos.	Pos.	,,	,,	Not found	,,	—	,,	,,
(21) Wt...	68	Pos.	N.O.	,,	,,	Meningo-cocci	Yes	Not found	,,	,,

N.O. = culture not obtained.

Roman numerals denote Gordon's four types of meningococcus as proved by serological tests.

Pos. = meningococcus grown, but serological tests not performed.

Meningococci = organisms having the morphological and staining characteristics of the meningococcus seen, but not grown.

B.—Cases with known Recrudescences.

Name	Number of days from onset to—		C.S.F. type	Nasal type	Crib. eth-moid	Sphenoidal sinus		Sphenoidal bone		Pituitary fossa	Middle ear
	Recru-descence	Death				Empyema	Meningo-cocci	Em-pyema	Meningo-cocci		
(22) Mn...	8	8	II	II	Nil	Yes	Meningo-cocci	Nil	—	Inflam.	Nil
(23) Ws. ..	5	9	I	I	,,	,,	I	,,	—	,,	,,
(24) Pu. ..	9	14	I	I	,,	,,	I	,,	—	,,	,,
(25) Co. ..	12	16	III	I or III	,,	,,	Meningo-cocci	,,	—	,,	,,
(26) Bo. ..	42	48	II	N.O.	,,	Normal	—	,,	—	,,	,,
(27) Hp. ..	Repeated Recru-descences	99	Pos.	Pos.	,,	Yes	Meningo-cocci	,,	—	,,	,,
C.—Convalescent Cases dying from Hydrocephalus.											
(28) Sp. ..		87	Pos.	II	Nil	Yes	Not found	Nil	—	Inflam.	Nil.
(29) Ck. ..		90	Pos.	Pos.	,,	,,	Meningo-cocci	,,	—	,,	,,
(30) Fl. ..		93	II	II	,,	,,	II	,,	—	,,	,,
(31) Tr. ..		109	Pos.	N.O.	,,	,,	Meningo-cocci	,,	—	,,	,,
(32) Mu...		133	Pos.	I	,,	,,	I	,,	—	,,	,,
(33) Ce. ..		147	Pos.	II	,,	,,	Not found	,,	—	,,	,,
(34) Br. ..		199	I	I	,,	,,	,,	,,	—	,,	,,

N.O. = Culture not obtained.

Roman numerals denote Gordon's four types of meningococcus as proved by serological tests.

Pos. = Meningococcus grown, but serological test not performed.

Meningococci = organisms having the morphological and staining characteristics of the meningococcus seen, but not grown.

In a previous paper [2] it was shown that of thirty cases in which it was possible to obtain cultures from both the nose and the cerebrospinal fluid, in thirty-five the types of the meningococci in the two sites were identical, as proved by both agglutination and saturation tests. The irregularity shown by the remaining case has been discussed.

In no case was any inflammatory process discoverable about the cribriform plate of the ethmoid by naked-eye examination.

The contents of the pituitary fossa showed inflammation in every case. The middle ear was seen to contain pus in one case, and there was congestion of the bone, but no pus, in another case.

There was an empyema of the spenoidal sinus in :—

(*a*) Acute case deaths—twenty out of twenty-one cases.

(*b*) Recrudescence deaths—five out of six cases.

(*c*) Hydrocephalus deaths—seven out of seven cases.

An empyema of the sphenoidal sinus is taken to mean a cavity filled with pus, muco-pus containing fresh and autolysed pus cells or glairy fluid showing pus cells, and the mucous membrane of the sinus showing congestion. Thus in thirty-four post-mortems, an empyema of the sphenoidal

sinus was present in thirty-two cases. In the pus from the sphenoidal sinus :—

Meningococci were proved serologically in eight cases.

Meningococci were cultured but were not tested serologically in two cases.

Meningococci were seen but not grown in ten cases.

No meningococci were seen or grown in twelve cases.

Inflammation of the sphenoid bone over the empyematous sphenoidal sinus was not found at all in recrudescence and hydrocephalus deaths, but was found in seven cases of deaths from the acute illness. In these seven cases the meningococcus was only found three times, and the type of the meningococcus was only able to be proved once, but was in this case the same as that found in the nose and cerebrospinal fluid.

The association of sphenoidal sinus inflammation with cerebrospinal fever was first noticed by Westenhoeffer [3], who only found it to occur in one-third of his twenty-nine necropsies. Other workers have also reported cases showing empyemata of the sphenoidal sinus, but have generally considered that this condition is not the cause of the disease, either because they have been unable to find an empyema in all cases, or because they have been unable to trace the meningococcus in the walls of the sphenoidal sinus or in the body of the sphenoid bone. Very great improvements have recently been made by Mervyn Gordon in the culture medium for the propagation of the meningococcus, so that a meningococcus can now, under suitable circumstances, be made to grow as rapidly and luxuriantly as a *Bacillus coli*. These improvements were not available for most of the workers in this connexion. In spite of these advantages the meningococcus was not demonstrated in the sphenoidal empyema in twelve of these cases. This was possibly due to the length of time that elapsed between death and the necropsy in many cases, and also to the chilling of the plates during transport from a distant camp to the laboratory in very cold weather. The majority of deaths occurred during cold weather, and meningococci are difficult to cultivate in primary culture unless precautions against chilling are taken.

Thus in 34 deaths from cerebrospinal fever, empyemata of the sphenoidal sinus were found 32 times, meningococci were found 20 times in the sinus and 3 times in the sphenoid bone. In no other diseases were empyemata of the sphenoid sinus observed, except during the epidemic of "Spanish influenza," when empyemata of the sphenoidal sinus were frequently found.

The relationship between an empyema of the sphenoidal sinus and cerebrospinal fever may now be considered. The primary site of a meningococcus infection in the human body is undoubtedly the nasopharynx. The meningococcus has been demonstrated in this position not only early in the acute attack, but also in the incubation period [4], in carriers who never develop meningeal symptoms, in meningococcal pneumonia, etc. The infection is propagated from person to person, as is a common cold,

from nose to nose. The frequency of the carrier condition and the relative infrequency of the disease is noteworthy. It is probable that the whole population of England has been a carrier at some time or other during the last five years, and yet the total number of cases is relatively small.

At the time when contacts to cases of cerebrospinal fever were examined for the carrier condition, it was always noticed that the people under examination were suffering from coughs and "colds." Many of the contacts gave pure cultures of the meningococcus in the nasopharynx. This suggested that the "colds" were in some cases due to the meningococcus. Also several carriers, when first isolated, suffered from a profuse, watery nasal discharge, from which only the meningococcus could be isolated. Chronic carriers nearly always had a gluey nasal discharge, which was apparent on examination of a nasal swab. It thus appears that the meningococcus can give rise to nasal catarrh. It seems probable that this is the natural disease produced by this organism, and it is only when some other factor comes into play that meningitis or septicæmia results. This other factor does not seem always to be a rise in virulence of the meningococcus, for of the camp epidemics about Southampton and Winchester during the war it was only in one epidemic that all the cases of meningitis were due to one serological type of meningococcus. Usually two or three serological types of meningococcus were recognized in the cases of one epidemic, the carriers found in the camp corresponding with the serological types of meningococcus in the cases. Thus in the Winchester epidemic of the spring of 1917 there were 8 cases, 3 due to Gordon's Type I coccus, 2 due to Gordon's Type II, 2 due to Type IV and 1 in which the type was not proved. The carriers found were all infected with one of these three types of meningococcus, no Type III carriers were found. On another occasion two cases occurred in one ward in a hospital within four days of one another. If serological tests had not been performed, it would have been felt certain that either one case infected the other, or that both were infected from the same source. This was not so, as the first case was due to Gordon's Type II, and the second due to Gordon's Type I or III coccus.

Some epidemics in other parts may have been produced by a particularly virulent type of meningococcus of one serological type, but it is evident that this is by no means a necessary condition for the outbreak of an epidemic.

The frequency of the appearance of a sphenoidal sinus empyema suggests that this might be the determining factor in the onset of the meningitic form of the disease at any rate. The empyema may be the result of an inflammatory reaction to the meningococcus, on the part of the mucous membrane lining the ostia. The fact that the meningococcus was several times isolated in pure culture from the sinus suggests that, for the inflammatory closure of the ostia, a mixed infection is not necessary, although streptococci and staphylococci were also found on occasions to be present. Thus a sphenoidal empyema might be produced by a meningococcal infection of the nasal mucosa of an individual, whose resistance to the

meningococcus was such that the infection resulted in a vigorous inflammatory reaction. Anatomical or pathological peculiarities in this region might also favour the production of an empyema.

In cases dying from cerebrospinal fever, an empyema of the sphenoidal sinus was common, in only two cases in this series (17 Su. and 26 Bo.), out of thirty-four, was this condition not found. Both these cases died at a considerable number of days from the onset, twenty-seven and forty-eight respectively. Forty-seven completely recovered cases on the other hand were examined by rhinological experts, Dr. Peters and Dr. Bryant, who found that no sphenoidal empyemata were present. Chronic carriers [5] were also carefully examined bacteriologically, and no meningococcic infection of the sinus was found. Thus in dying cases an empyema was frequently found; in completely recovered cases no empyemata were discovered. A series of five cases showing symptoms of hydrocephalus were operated on for drainage of the sphenoidal sinus [6]. Of these cases all showed the presence of a sphenoidal empyema. The meningococcus was only cultivated and proved serologically in one of these cases from the sphenoidal pus obtained at the operation, a typical Gram-negative diplococcus was seen only but not grown in another case. But in two other cases, subsequent to the operation, the meningococcus reappeared in the throat in pure culture, after it had entirely disappeared for some weeks previously. Subsequent to the operations all cases appeared temporarily worse, three made complete recoveries, two died with typical hydrocephalus post mortem. Of the recovered cases one went through a typical relapse after the operation, with reappearance of the meningococcus and pus in the theca, subsequently completely recovering.

From this it would seem that if early and vigorous serum treatment be given, and if the sphenoidal empyema disappear, recovery will probably occur; if, however, the empyema persist the case will, if it recover from the acute illness, either relapse or go on to hydrocephalus.

In order to see if draining the sphenoidal sinus during the acute stage of the illness would accelerate recovery three cases of cerebrospinal fever were operated upon; a sphenoidal empyema was found in each case, but each case died. This discouraged further operative procedure during the acute stage.

The next point under consideration is, how do the meningococci get from the nasal mucosa to the meninges?

There are many possible routes :—

(1) The arachnoid prolongations round the olfactory nerves.
(2) The perineural lymphatics.
(3) Direct inflammatory extension.
(4) The pituitary.
(5) The systematic lymphatics.
(6) The blood-stream.
(7) The middle ear.

(1) THE ARACHNOID PROLONGATIONS ROUND THE OLFACTORY NERVES.

This route is favoured by Netter and Debré and Flexner. Netter and Debré show that dyes, Indian ink and meningococci can get from the cerebrospinal fluid into the nose by this route, but they do not show that the reverse can take place. Their experiments show that the natural direction of the currrent is from the cerebrospinal fluid to the lymphatics; it is thus difficult to see how the meningococci could progress against the stream, to gain access to the meninges, except by inflammatory extension. In none of this series of post-mortem examinations was there any naked-eye appearance of inflammation about the cribriform plate of the ethmoid.

(2) THE PERINEURAL LYMPHATICS.

In papers by Orr and Rows [7], Teale and Embleton [8], it had been shown that not only dyes and toxins, if injected into a nerve will travel up the perineural lymphatics to the cord, but also particulate material, such as washed spores. These spores can be traced up the perineural lymphatics into the substance of the cord itself. In this way it might be possible for the meningococci to travel up the perineural lymphatics into the brain substance. Cerebrospinal fever does not, however, appear to start as an encephalitis, so although this route would be a satisfactory one for polioencephalitis, it does not seem suitable for cerebrospinal meningitis, especially as it has been shown that neither toxins, dyes nor particulate material, when passing up a perineural lymphatic, get into the cerebrospinal fluid.

(3) INFLAMMATORY EXTENSION.

It has been suggested that meningococci could gain access to the cerebrospinal fluid by a process of inflammatory extension through the bone separating the nose and accessory sinuses from the meninges. In this series of necropsies, there is evidence of direct spread from the sphenoid sinus to the sphenoid bone, and so to the overlying meninges. In seven cases there was inflammation, and the meningococcus was found three times in the bone. In the other cases no evidence, as viewed by the naked eye, of inflammatory extension could be discovered.

(4) THE PITUITARY ROUTE.

An infection from Luschka's pharyngeal tonsil along a possibly patent connexion between this and the pituitary gland has been suggested. Luschka's tonsil is one of the sites in the nose most richly infected with the meningococcus. In this series of necropsies the pituitary body always showed infection, but it is obvious that this would certainly occur anyhow from its intimate relationship with the cerebrospinal fluid.

(5) THE SYSTEMIC LYMPHATICS.

The ordinary flow of lymph from the nasal passages is away from the brain, and in connexions between the subarachnoid space and the lympathic

system the current is away from the meninges. If bacteria are injected into the arachnoid space they rapidly appear in the lymphatics of the head and neck. If however a process occurs such as an empyema of the sphenoidal sinus, the ordinary direction of lymph flow might be reversed, and bacteria be thus forced from the lymphatics of this neighbourhood towards the meninges, without showing any sign of inflammatory extension. In the case of a sphenoidal empyema large numbers of meningococci would get into the lymphatics, and by this means would also get into the blood-stream. It would only be necessary for a sphenoidal empyema to exist for a very short time to produce these effects, possibly only for half an hour. If the sphenoidal empyema discharged at the end of a short time into the nose, and if the meningococci that had reached the meninges were destroyed, a recovery would ensue. If, however, the sphenoidal sinus empyema persisted, and kept on pouring fresh infection into the meninges, the case would probably die.

(6) The Blood-stream.

Many workers have considered that the infection of the meninges occurs by way of the blood-stream, the meningococci gaining access to the blood from the nasopharynx. This suggestion has been based, partly upon the early appearance of the meningococci in the blood, and partly on those cases of meningococcal infection where no meningitis occurs. The blood-stream, however, would receive meningococci very early in the infection of the nasal mucosa, at any rate as soon as an empyema of the sphenoidal sinus occurred. The meningococci would reach the blood-stream from this region via the deep cervical lymphatic trunks, which join the thoracic duct just before it enters the venous system in the neck. Also, as soon as the meningococci gained access to the cerebrospinal fluid, they would appear [9] in the blood-stream, both direct, via the Paccionian bodies, and also by way of the lympathics, through their junctions with the sub-arachnoid space. The blood then would, from the very earliest stages of the disease, receive repeated and heavy showers of meningococci from the sphenoid region and the cerebrospinal fluid. Thus it can be said that the early finding of the meningococcus in the blood-stream is no indication that the meninges are primarily infected by this route.

In the recent outbreaks of "Spanish influenza" empyema of the sphenoidal sinus was a common finding in the fatal cases, but meningitis was rarely found. It is not necessary then that an empyema should be followed by meningitis. It is thus possible that the meningococci can gain access to the blood-stream from a sphenoidal empyema and so be carried round to the meninges and set up inflammation.

(7) The Middle Ear.

Inflammation of this region was only found in two necropsies in this series. It is unlikely that this is the portal of entry of the meningococcus to the meninges.

Thus it would appear that it is improbable that the meningococci gain access to the meninges through the arachnoid prolongations round the olfactory nerves or by way of the perineural lymphatics. It is probable that the meningococci pass by way of the lymphatics from the sphenoidal sinus direct to the meninges, with or without naked-eye signs of inflammation. It is possible also that they can be conveyed to the meninges by the blood-stream.

The relationship between a persistent sphenoidal empyema and hydrocephalus may now be considered.

In the seven deaths from this condition an empyema was found in each case. Five cases were operated on and pus was found in the sphenoidal sinus each time, two of these cases died and are grouped in with the post-mortem cases. There were thus a total of ten cases of hydrocephalus, and in each case a sphenoidal empyema was found. The cerebrospinal fluid in the ventricles of each of the cases which died contained pus cells. The cerebrospinal fluid taken from the lumbar region was usually quite clear. This suggests that there is a close relationship between empyema of the sphenoidal sinus and the hydrocephalus that develops after an attack of cerebrospinal fever. The hydrocephalus develops as a result of a chronic infection about the foramina of Luschka and Majendie. This chronic infection also appears to exist in the ventricles. The exact path by which the meningococci in the sphenoidal sinus empyema reach the interior of the ventricles is not clear, unless it be by the blood-stream. But there would appear to be some relationship between the two positions inasmuch as the only three cases who recovered from the hydrocephalus condition did so after an operation for drainage of the sphenoidal sinus. It might be argued that these three cases who recovered were not examples of hydrocephalus at all. Against this it is urged that all five cases operated on were advanced cases with typical symptoms, the two that died showed typical necropsies, and all other cases showing these symptoms died with typical necropsies.

The course of events in a case after infection of the nasal mucous membrane with the meningococcus might be as follows:—

(1) A simple catarrh followed either by recovery or a chronic infection.

(2) A vigorous local reaction in the nasal mucosa followed by sphenoidal empyema. This may produce a general blood infection with or without infection of the meninges.

If the sphenoidal empyema disappears, the body, with or without the aid of antiserum, may be able to deal with the meningococci that have gained access to it or death may result. If the sphenoidal empyema persists and very heavy discharges of meningococci are poured into the body death will probably result. If, however, the empyema remains quiescent improvement may occur, but at any time a recrudescence or a relapse may supervene. A quiescent empyema may also keep up a smouldering infection which will lead to hydrocephalus.

Operation on the sphenoidal empyema always produced an increase in general symptoms. During the acute stage of the disease this increase in symptoms appeared to accelerate at any rate a fatal termination. In hydrocephalus cases recovery did occur in three cases, though one case went through a severe relapse.

Summary.

(1) In thirty-four necropsies on persons dying from cerebrospinal fever empyema of the sphenoidal sinus was found thirty-two times.

(2) In ten cases of hydrocephalus following cerebrospinal fever an empyema of the sphenoidal sinus was found in every case.

(3) In forty-seven completely recovered cases of cerebrospinal fever no sphenoidal empyemata were present.

The author wishes to acknowledge his indebtedness to Miss Iris Harmer for her valuable work in connexion with this research.

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Clinical and other Notes.

MIXED *B. PARATYPHOSUS* A AND B, INOCULATIONS WITH SERUM-TREATED BACILLI.

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THE following article is prepared from the official report to the Director of Medical Services, Malta Command. It is published as it describes the first series of inoculations with mixed anti-paratyphoid A and B vaccine carried out on an extended scale in the British Army; and, as particular facilities for following the immediate and subsequent results presented themselves, they appear not without interest.

Towards the end of October and early in November, 1915, it was noted that paratyphoid A and B fevers were being contracted by the personnel of the hospitals in Malta, where cases from Gallipoli were being received. It was then that I recommended and made a request through Colonel Gulland, A.M.S., to Surgeon-General Sir H. R. Whitehead, the D.M.S. Malta, that sanction might be given to prepare preventive paratyphoid inoculations and administer them on a voluntary plan.

In July, 1915, a mixed paratyphoid vaccine had been prepared and issued from the Vaccine Department, Royal Army Medical College,[1] and Lieutenant-Colonel Cummins[2] had previously carried out some mixed *B. typhosus* and *B. paratyphosus* A vaccine inoculations at the Royal Army Medical College. The earliest employment of mixed enterica vaccine dates from Castellani's work in 1905, but for some unacountable reason, and its falsity has been proved by experience, there existed in the minds of many a strong prejudice against paratyphoid inoculation because of the very severe reaction anticipated from the injection of *B. paratyphosus* B.

From comparative inoculation of fifty subjects following the injection of five different strains of *B. paratyphosus* B, obtained from blood cultures, I found that though two, one having been isolated as the causative micro-organism of an epidemic from food poisoning, and showing by the absorption test a certain relationship to the *B. aertryck* group, were extremely toxic to man as they were also to the mouse, yet the others were not so toxic. In the original researches the experience gained from the injections of the three latter strains led to the selection of one which gives but a mild reaction while promoting a rich response in antibodies for the several strains of the group tested (*Lancet*, September 24, 1914). In the same paper are given the initial experiences with the strain of *B. paratyphosus* A that was used also in the inoculations in Malta.

In the preparation of this mixed vaccine the strains employed were cultured separately on peptone agar in Roux bottles for twenty-four hours at 37° C., then

[1] Garrow, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. xxix, p. 421. 1917.
[2] Cummins and Cumming, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. xxi, p. 282. 1913.

washed off in ten cubic centimetres normal sterile saline, centrifuged and the deposit of the bacilli emulsified in three cubic centimetres per Roux bottle of normal sterile saline. These emulsions were heated for one hour at 53° C. for *B. paratyphosus* A, and 56° C. for *B. paratyphosus* B. A platinum loopful thereof was then taken and the number present per cubic centimetre determined by the Thoma-Zeiss counting chamber. Twice the quantity of inactive normal horse serum was added to each tube containing the emulsified bacilli. After one hour at 37° C. and a night in the ice-chest the tubes were again centrifuged and the deposit emulsified in normal sterile saline containing 0·5 per cent carbolic acid, so that each one cubic centimetre contained 1,000 million bacilli. A loss of ten per cent of the bacilli during the further preparation was allowed for. The emulsions of each strain were then mixed in equal proportions and, proving pure and sterile, were issued in twenty cubic centimetre rubber capped bottles.

Three doses one quarter, one half, and one cubic centimetre were recommended and given whenever possible, the interval between them being seven or eight days. Over eighty per cent were so inoculated. The greatly diminished local reaction that follows the injection of these and other micro-organisms when treated with inactive normal horse serum has been discussed in a previous communication.[1] It was again noteworthy. The number inoculated—2,531—included officers, nurses, non-commissioned officers and men mainly of the hospital's personnel. The inoculations began in November, 1915, when Colonel Purves Stewart, C.B., A.M.S., joined me in being the first to receive the vaccine and our example was helpful in the plan of encouraging men to be inoculated. Within one month 2,000 persons had been inoculated or were willingly undergoing the inoculations.

These were carried out in various hospitals by medical officers specially detailed to do so and to make observations and forward them to me in the reports, which were summarized and sent to headquarters. Prior to undertaking this work these officers met, and details in connexion with the preparation, doses, &c. of vaccine were explained. The ready collaboration and interest of Officers Commanding hospitals and of these medical officers were of invaluable assistance and led to the high percentage of personnel inoculated, which in more than one hospital exceeded ninety per cent.

Reactions were mild or *nil* in all but twelve, and such results are of great importance when viewed from the administrator's and the subject's standpoint. Save for these twelve leave from duty for twenty-four hours was not necessary or requested. Four men showed what might be termed inoculation fever; this was characterized by a raised temperature beginning on the night of inoculation and lasting five to seven days, falling by lysis to normal. One man developed a scarlatiniform rash within thirty-six hours after the first, but had no reaction after the second injection.

As the inoculations were carried out during an epidemic of paratyphoid fevers and so few cases were reported amongst the personnel during their inoculations, such inoculations do not appear, in the doses given, to give rise to a negative phase in the subject. Three men during the course of their inoculations were bacteriologically proven to be suffering from paratyphoid fever, due to *B. paratyphosus* A (two), or *B. paratyphosus* B (one). The three recovered, and save in one case of *B. paratyphosus* A who had but a one-quarter cubic centimetre of

[1] *British Medical Journal*, August 8, 1914.

vaccine two days before the declaration of fever they had very mild attacks of the disease. In another hospital there were two other cases which were diagnosed on clinical grounds only, no confirmatory bacteriological evidence being obtained, as suffering from paratyphoid fever of exceptional mildness. These results, though the cases are few, point to no deleterious, and perhaps to a beneficial effect from inoculation early in infection. My results from the treatment of paratyphoid fever with serum-treated vaccine further these premises.

An attempt was made to draw up statistical results from the incidence of paratyphoid fever amongst the inoculated and non-inoculated, but such has been unfortunately impossible with accuracy for several reasons, mainly the changes in personnel and the report of certain cases as "enterica" without classification. However, sufficient evidence could be gained from a survey of all cases during the three months prior to and six months following the inoculations to show the total incidence of paratyphoid fever became to a definite degree quickly reduced. Infection in an inoculated person was of very rare occurrence.

Inoculations were given to 136 of the ship's complement during an epidemic of paratyphoid A fever on board H.M.H.S. "Panama" when at Malta. There followed an immediate cessation of the disease, and no fresh cases had arisen up to a month later when the last report was sent by the medical officer in charge. It must be added that special sanitary measures were adopted at the same time as the inoculations were begun.

Agglutination Findings.—From the agglutination test done by my time-governed slide method on a number of unselected inoculated people it was found that specific agglutinins for both *B. paratyphosus* A and B were detected in the blood on the sixth to eighth day. The specific agglutinins for *B. paratyphosus* A tended to disappear at about the sixth month, very rarely earlier, while those for *B. paratyphosus* B tended to disappear about the tenth to twelfth month after inoculations. There was a slight temporory rise in the specific agglutinin for *B. typhosus* when previously present in response to earlier antityphoid inoculations.

I beg to thank Colonel J. R. Robertson, I.M.S., S.S.O., and Lieutenant-Colonel C. Cumming, R.A.M.C., and Major A. Elliot, Officer in Command of Imtarfa Hospital, for their valued interest in the work, also my collaborators, and Staff-Serjeant R. J. Dermody and Corporal G. Dodd for their great help in the preparation and bottling of the vaccine, which frequently had to be done at night after the completion of the routine laboratory work.

THE QUESTION OF NATURAL ENEMIES.

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One has not to go far in the study of anti-mosquito measures before meeting the time-worn doctrine about the control of mosquitoes by natural enemies. It is one of the "standard" suggestions, still carrying with it to the student a charming sense of a delightfully potent weapon supplied by Nature, as an aid to his other carefully thought-out anti-measures.

It is far too generally believed that fish and insects predaceous on mosquito

larvæ are of immense value. Unquestionably they are of some value, but only under the most *unnatural* conditions.

If the so-called natural enemies had anything like the power with which they are often credited they would deserve a better name. The balance of Nature is much too stable a thing to be so easily upset. One must remember that in Nature the natural enemies generally exist side by side with mosquitoes, and yet the latter thrive unchecked; and that to introduce fish and other natural enemies is often like bringing coals to Newcastle. The maxim is, "under *un*-natural conditions natural enemies may be utilized sometimes with advantage."

Make the natural conditions as unnatural as possible, and one then temporarily upsets the balance of Nature, allowing the enemies a freer action with a beneficial result sometimes as far as man is concerned.

We have around us at Sandwich innumerable anopheline breeding places in the system of dykes that cover so many miles of this part of the country. Here almost all the natural enemies of mosquito larvæ that have ever been cited as such may be found living side by side with the larvæ. Small fish and notonecta (the water-boatman) live in the waters of the dykes in myriads, and yet there is no scarcity of anopheline larvæ in the same water, and at all stages of their development.

I have been particularly struck with the often repeated suggestion from people who have heard of the "natural enemy theory" that "millions" might be introduced here advantageously and the mosquitoes thereby controlled. Yet it is easy enough to demonstrate that the fish in the dykes are themselves voracious larvæ eaters in the laboratory, but in spite of this they are still of little use under natural conditions. If in the natural condition of a locality larvivorous fish already exist, it is generally an utter waste of time introducing others.

The whole question of "natural enemies" is mixed up with the less obvious factor, but the factor of prime importance, i.e., simply the rendering of existing conditions unnatural. Here in Sandwich it is upon this achievement only that success or failure turns. Our course is the clearing of the vegetation from the water surface, and sides of the dykes, and cutting the sides so that sheer edges are formed. Probably in-so doing the natural enemies are enabled to attack the larvæ more easily, but this is only a cog in the system of larvæ destruction, and not the whole of the machinery. Natural enemies count for very little indeed in Nature as far as practical politics are concerned, unless conditions are quite unnatural.

Let us consider therefore under what conditions natural enemies can with advantage be employed, and as, for all the enemies cited as such, fish are the only enemies that have been proved of any real importance, my remarks are confined to fish.

The cardinal point of advantage is of course introducing larvivorous fish into localities where none previously existed, but one must take into account the environment demanded by the fish themselves. It is no use introducing fish into stagnant pools for instance if the pond is too foul for the fish to live in. It is equally useless introducing fish into streams with swampy land on each side of the main current, unless the swampy ground is drained by a system of "herring-bone" or other waterways, up which the fish may ascend, and in order

that they may do so the waterways must be kept clear of weeds and vegetation of all sorts.

In Africa during the recent campaign larvivorous fish were introduced from Zanzibar and placed in a lake with swampy surrounding ground, but it was soon found that until the latter was well drained by a system of shallow waterways, and these waterways kept clear of vegetation constantly, so that the fish could ascend and descend, there was no marked reduction of the anopheline larvæ. In other words, "no result until conditions had been made quite unnatural."

The most striking application of the use of fish as natural enemies with beneficial results is the introduction of larvivorous fish into water tanks where anophelines are breeding and where the water cannot be treated with oil or other larvicides, as, for instance, drinking water reservoirs. But this success is due in the main to the fact that the anophelines are living in conditions not provided by Nature and wholly artificial.

One finds all this is true for the whole subject of control of insects by natural enemies, and is not merely confined to the control of mosquitoes. It was once thought in America that by the introduction of a certain foreign species of *Coccinellidæ* ("lady-birds") that is predaceous on a woolly aphis which caused great economic loss to fruit farmers in California, a splendid means of extermination of the aphis had been hit upon. By the introduction of the "lady-birds" an unnatural condition had been set up, and all went well for a time, to the great delight of everyone concerned: All might have continued well if it had not rested with Nature to have the first and last say in the matter. Her universal demand that a balance be struck in the operation of her affairs prevailed, and in a short time the introduction of the "lady-birds" for the purpose they were to have achieved failed miserably, and the insects were ultimately, I believe, more of a curse than a blessing.

Natural enemies alone will never be a solution to the control of any animal, and it is time that we recognized that the credit given to them is a credit largely due to the advantage that is sometimes gained by man in his ingenious ability to upset the balance of Nature temporarily.

I have no faith in natural enemies as a means of control. Far greater certainty in anti-mosquito measures is always attained by the employment of purely mechanical and chemical agents with the aim at rendering conditions unsuitable to the larval development.

THE DANGER OF THE CONCRETE PILL-BOX.

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In the Struma Valley in 1918, a Royal Army Medical Corps officer was asked by the Assistant Director of Medical Services, 27th Division, to be present at a test in a concrete machine-gun emplacement, or "pill-box," in order to take samples of the air as soon as the firing ceased.

When in action in the open type of emplacement on former occasions, some of the gunners complained of a feeling of giddiness and faintness. It was suggested that this was due to the escape of carbon monoxide from the breach along with

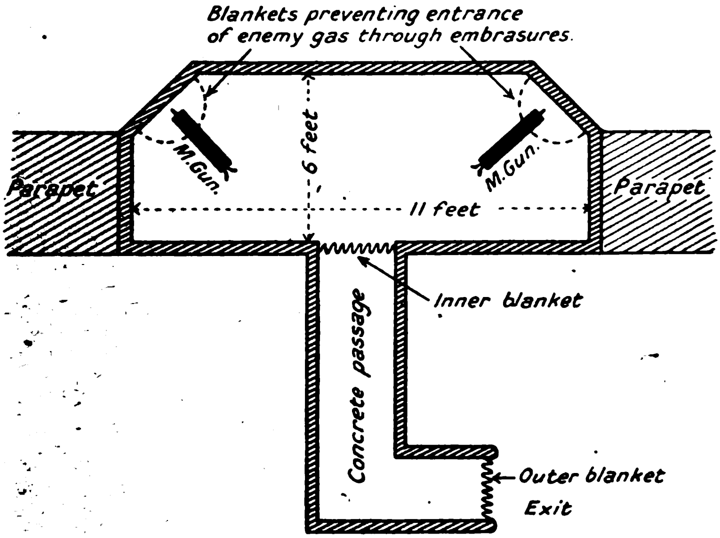
the disused cartridges, and it was thought that in an unventilated pill-box which was made proof against enemy poison gas carbon monoxide would be present in such a high concentration as to be dangerous to the gunners.

The experiment was almost too successful, the Royal Army Medical Corps officer and one man being badly gassed, the three others not suffering so severely.

The emplacement was built of concrete and was shaped like a rectangle with two of its corners cut off; it was in these corner walls that the embrasures were situated.

The interior was 11 feet by 6 feet by 5 feet in height, and had a cubic capacity of less than 300 feet without allowing for the tables, guns, ammunition, etc. There was one air outlet in the roof of about five inches in diameter.

The only air inlet was through the concrete passage which was completely roofed over and had a right-angled bend near the outer door. This passage was about six feet in length.



Concrete pillbox.

The inner and outer doorways had blankets stretched across them and a sand bag had been stuffed into the roof ventilator. This was intentionally done to keep out enemy gas. Even the embrasures were so arranged that the guns could fire through but that enemy poison gas could not enter. In short, the pill-box was supposed to act as a gas helmet for the five men inside it.

Under ordinary conditions the personnel consisted of two men to each machine-gun and one machine-gun officer; in all, five.

The following account is taken from the report of the Royal Army Medical Corps officer who was in the pill-box during the test:—

"Immediately firing started a Staff officer and myself entered. The number of occupants was seven when the first belt was being fired. After a few minutes firing the machine-gun officer went out. He was followed a little later by the

Staff officer. There was no artificial light and at first it was difficult to make things out. I seated myself between the two guns and busied myself in getting ready to take the samples of air. These were to be taken by emptying the sample bottles which had been previously filled with water.

"Suddenly No. 1 of the left-hand gun dropped back to a sitting position on his heels. I shouted, 'Are you all right?' and getting no reply, I dragged him into the passage and along to the outer door where someone took him from me.

"By this time the outer blanket had been removed and light was admitted into the corridor. I saw another man on his knees in the inner doorway in a devotional attitude. I thought at first he was praying, but I soon noticed that his hands were fixed in the position he would take up were he No. 1 of the gun crew. I seized him and dragged him along to the outer door. While I was doing this a third man rushed out of the pill-box, clambered over both of us, and made his escape.

"I can't remember much of what happened after this. My mind was centred on getting the sample bottles and fortunately I went back to seek for them. It was then that I tripped over the fourth man lying in a corner; he had been forgotten in the confusion and darkness. I hauled him out by the feet into the passage and returned for my samples. I got three out of the four bottles, stumbled into the passage and became unconscious."

The case is interesting because Dr. ——— is able to describe how he felt during a convulsion caused by carbon monoxide poisoning. Convulsions are apparently rare in this type of poisoning, and there is no very full description in any of the works I have since consulted. It is also interesting because of the simplicity of the test by means of which we established the presence of carbon monoxide in the air sample, a test which could be readily used in the bedside diagnosis of cases of suspected CO poisoning, such as we got abroad during the last three or four winters when charcoal braziers were so much used in dug-outs.

"The Assistant Director Medical Services told me I had been unconscious about ten minutes. When I came round, except for a feeling of fulness in the head, I felt I had got over the worst, but about ten minutes later I began to feel a sensation of tingling and numbness creeping up my arms and legs. This was accompanied by severe muscular spasm and tremor. The adductor and opponens muscles of the thumbs were first affected, the thumbs becoming fixed across the front of the palms.

"The muscles of the forearm were next affected and in such a manner that the whole hand was flexed and inverted. The spasm gradually spread to the muscles in front of the upper arm, the arms becoming so flexed and so painful that I asked some men to pull on my hands and keep my arms stretched out at right angles to my body. This gave me great relief especially when the pectoral muscles became affected. At this time the most marked spasm was that of the muscles around the mouth. My mouth became so fixed that I could not pronounce words although I could make a noise with my voice. To those around me it must have appeared like what is described as "risus sardonicus." The muscles of the lower extremities were by this time so much contracted that my knees were flexed to the fullest extent. Curiously enough, I am unable to state whether my thighs were flexed on my abdomen. Tremor developed in my arms and legs and I was unable to keep them still. The abdominal muscles and the pectorals were the last to be affected

and so severe was the spasm that I experienced a feeling of suffocation and I began to think I should not recover. My respirations became very rapid and, according to Colonel ——, my pulse, which was good at first, became weak and rapid and almost disappeared. In a few minutes the spasm went off, and, excepting for a feeling of fulness in the head, I felt almost normal.

"In about ten minutes I had a much milder spasm which only affected the hands; and, finally, a third which was scarcely noticeable.

"During these spasms I was under the impression that my mind was quite clear, but Colonel —— told me afterwards that I was certainly talking nonsense when the convulsion was at its height. I had no nausea, and headache was never marked, although I felt afterwards as if I had been 'sand-bagged.' There was a great tendency to sleep and a feeling of weariness. I heard that two of the other victims vomited and that some complained of headache.

"The guns were in action about fifteen minutes. The first man collapsed after ten minutes had elapsed, and the last when he had started firing his fifth belt.

"The delay in the onset of symptoms in my case is easily explained. I entered the pill-box a little later than the others and I was seated near the floor and between the two guns. The others were standing and bending over the breach, thus getting a greater concentration of the products of combustion.

"On the other hand the greater severity of my symptoms must have been due to my getting a larger dose of gas as the result of the exertion required to remove three unconscious men."

This is an interesting description of an experiment which undoubtedly saved many lives. Had an attack been made by the enemy in the Struma Valley, and had we been using these pill-boxes, there is no doubt that within twenty minutes a whole line of machine-guns would have been out of action, with perhaps serious consequences.

I remember reading that after one of our successful offensives on the Western Front, pill-boxes were found full of dead Germans untouched by shell fire. It is likely that these were cases of carbonic oxide poisoning and were not due to shell concussion as was said at that time.

The samples were taken to No. 25 Mobile Laboratory to be tested for the presence of carbon monoxide. A veterinary officer kindly supplied me with a quantity of mule's blood. I defibrinated this and shook it up with the air sample in order to absorb the CO as Carboxyhæmoglobin. I then tested for this substance, at the same time doing a control with normal blood, as follows:—

A five per cent watery solution of mules' blood which had been previously defibrinated was made up and ten cubic centimetres were introduced into the sample bottle. The bottle was protected from light and was well shaken for some minutes. It was then emptied into a test tube and to it were added fifteen cubic centimetres of a twenty per cent solution of potassium ferrocyanide and two cubic centimetres of a thirty-three per cent solution of acetic acid. On mixing a characteristic reddish-brown precipitate was thrown down; the control gave a distinct greyish-brown precipitate. The difference in colour between the two precipitates disappeared very slowly.

This test definitely established the presence of carbon monoxide in the air sample.

I took one of the remaining samples to the Central Laboratory at Salonica. Being

told that suitable apparatus was not available I purchased some carmine in the city and attempted a colorimetric estimation in my own laboratory. I concluded that the sample was saturated to the extent of between sixty per cent and seventy per cent. This would be equivalent to about 0·3 per cent of carbon monoxide gas in the atmosphere of the "pill-box," but being so short of chemical equipment and having to improvise apparatus, I can't vouch for the accuracy of the quantitative analysis.

The qualitative test described above could easily be done at the bedside in cases of suspected CO poisoning. A cubic centimetre of the patient's blood should be taken and diluted to make a five per cent solution. The reagents, already mixed in a test tube, could be quickly added and the test completed in a few minutes. A control would not be necessary if one were familiar with the characteristic reddish-brown colour.

I desire to express my gratitude to Major-General Sir M. P. Holt, K.C.M.G., for permission to publish this article; and also to Lieutenant-Colonel Henderson, D.S.O., R.A.M.C., for his kindness and assistance when working under extremely adverse circumstances.

A SUSPENDED STRETCHER DESIGNED FOR THE CARRIAGE OF BADLY WOUNDED AND FRACTURE CASES BY MOTOR AMBULANCE.

By Captain A. H. COLEMAN.
Royal Army Medical Corps.

AND

Acting Quartermaster-Serjeant C. W. NEWELL.
Royal Army Medical Corps.

The evacuation of cases of fractures and gunshot wounds of the lower limbs and pelvis, and gunshot wounds of the chest and abdomen by motor ambulance is a serious problem. Some cases of this type were tried by mule litter, but at best this is a slow and tedious method, and could not be used for the removal of large numbers of cases.

The condition of the patient after a journey by motor ambulance has not been as good as desired. Even when motor ambulances are driven very slowly and over good roads there is a certain amount of vibration which cannot be avoided, and the patient rolls about in all directions and independently of the stretcher.

This new arrangement has been designed to clasp the patient to the stretcher so that he moves with the stretcher and to reduce the vibration to a minimum.

Description.

The apparatus consists of four broad clamps to fix the patient to the stretcher, four strong straps to suspend the stretcher in the middle of the ambulance and four straps to fasten the stretcher to the floor of the ambulance. Two strong springs are let into each strap to absorb the vibrations.

Clamps (see Diagram 1).—Each clamp consists of a plate (six inches by five inches (*A*) curved to the shape of the lower limb and well padded. To the plate is attached a square adjusting arm (*B*), six inches long, with countersunk

Fractured Limb Clamps.

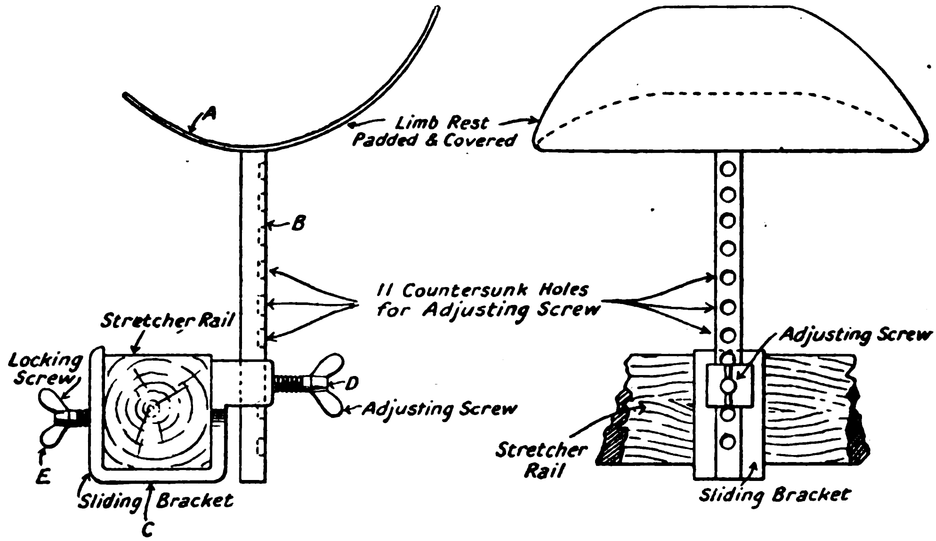


Diagram 1.—Scale: Half full size.

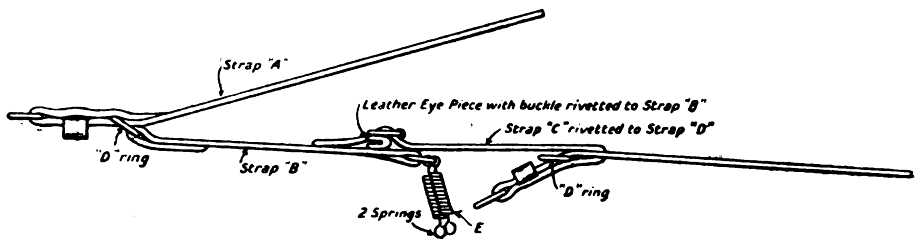


Diagram 2.—Scale: Quarter full size.

Details of Straps.

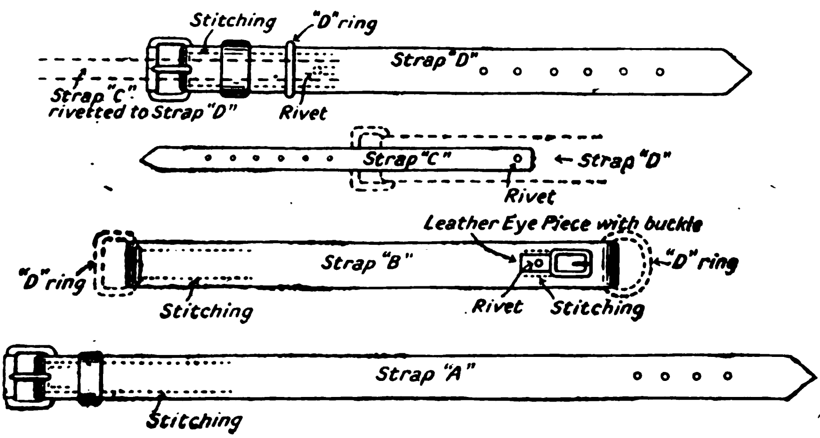


Diagram 3.—Scale: Quarter full size.

holes for the adjusting screw (*D*). This slides through the boss in stretcher clamp (*C*) and can be adjusted as required. Stretcher clamp (*C*) is made to fit on the average stretcher and is fixed by the locking screw (*E*). One clamp is fixed on either side opposite the hip-joint and one on either side below the knees.

Side Straps (see Diagram 2).—Four straps are used for suspending the stretcher. Each strap is composed of a strap (*A*) twenty-six inches long, and fastens round the stretcher rack support about the middle of the rack. Attached to this by means of a ring (*D*) is a shorter strap (*B*), fourteen inches long, ending in a "*D*" ring to which the spiral springs are fastened. On the upper part of this strap is a buckle for securing the safety strap. The lower half is a strap (*D*), eighteen inches long, which fastens round the handle of the stretcher. On the upper part of this strap there is a "*D*" ring to attach to the spring (*E*). On this strap, at the top, a safety strap (*C*), twelve inches long, is fixed. After the springs are hooked up, this strap is loosely buckled to strap (*B*) to allow the springs plenty of play and to act as a support in case a spring breaks. To prevent the stretcher swinging about it is fastened by four straps to four ring bolts let into the floor of the ambulance, two at the front and two at the rear of the car. A spring is let into each strap. The stretcher should be well pressed down while these straps are being fastened.

These measurements are for a 1914 Sunbeam Ambulance, but could be made to fit any car. The cost of the whole appliance is very small and could be made in the workshop of any motor ambulance corps.

The advantages of the suspended stretcher are :—

(1) That the patient, being firmly clamped to it, moves wherever the stretcher moves.

(2) The stretcher is suspended on springs in every direction, and although all movement is not eliminated it is reduced to a minimum and is fairly gentle and even.

(3) There is no loss of space because the ambulance can take sitting cases up to its full capacity, who could help to steady the stretcher over very rough roads.

(4) Patients can be evacuated soon after the injury is received, and at the ordinary speed laid down for motor ambulances.

The cases that have been evacuated by this method include fractured femur cases, gunshot wound of knee-joint, multiple gunshot wounds of buttock, in which case the patient rested on his side, and gunshot wounds of the thigh ; and none of these cases felt any pain or fatigue from the journey, and their condition was as good on being taken out of the ambulance as it was when they were put in.

A car fitted in this way would not prevent it being used for ordinary cases at any time.

NOTES ON A CASE OF GAS EMBOLISM, OCCURRING FROM GRENADE ACCIDENT.

By Captain A. B. PORTEUS
Royal Army Medical Corps.
Specialist Bacteriologist in the Colchester District.

The following case may prove of interest, being one in which a man died from gas in the heart. This gas originated, as far as the evidence showed, from the *Bacillus perfringens*, gaining entry into the wound in the leg, caused by a bursting grenade.

The following are notes from his clinical history sheet and post-mortem report:—

History.—Admitted to Military Hospital, Colchester, on the afternoon of May 24, 1917, suffering from a compound fracture of right thigh, the result of an accident during bombing practice. On admission the limb was fixed with temporary splints, he was in considerable pain. There was a large wound just above the knee on the inner side, the size of a florin, a small wound an inch lower on the outer side. A piece of bomb-casing was found in his trousers near the wound of exit. After splinting the limb, the man was quite comfortable and at 11 p.m. on the 25th inst., he suddenly became collapsed and cyanosed, dying at 1 a.m. on the 26th inst.

Post-mortem.—(Twelve hours after death). *External marks:* Patient was a large muscular man, wounds were present on the right thigh as mentioned above, the whole limb was very much swollen, and there was marked emphysema spreading upwards from the wound as far as the groin, and almost down to the ankle.

Larynx, Trachea and Œsophagus.—Normal.

Thorax.—Heart: Weight 15½ ounces. There was considerable dilatation of the right auricle and ventricle as well as of the pulmonary artery. On puncturing the right ventricle under water a considerable quantity of gas escaped. On opening the right auricle this cavity was found to contain frothy blood. There was also some ante-mortem clot in the right auricular appendix. The tricuspid valve was dilated and there was also frothy blood in the ventricle. The pulmonary valve was also dilated. The left auricle and ventricle were normal. Aortic valve normal. Lungs: There were adhesions of old standing over the outer surface and base of the right lung. There was an area of uncollapsed lung in the right upper lobe due possibly to an early embolic infarction. Elsewhere both lungs were congested but otherwise normal. Brain: Brain appeared normal except for a few petechial hæmorrhages in the cortex. Weight of brain 49½ ounces.

Abdomen.—Liver: Weight 74½ ounces. Normal. Kidneys: Right, weight 5½ ounces. Left, weight 5½ ounces. Both appeared normal. Spleen: Weight seven ounces. Normal. Stomach and Intestines: Normal. Bladder: Normal.

Remarks.—Death was due to gas embolism, the gas produced obstructing the circulation through the right side of the heart. The origin of this gas was, in my opinion, an organism in the wound which also produced the emphysema of the limb.

On examination of the pus from the wound taken at the time of the post-mortem, there were found in the film a large number of organisms, but noticeable

amongst them the long non-motile Gram-positive bacillus resembling *B. perfringens.* A few sub-terminal spores were present. There was also present a number of short Gram-negative spore-bearing organisms with a central spore in the fresh film. The pus was cultured in various media. It rapidly liquefied gelatine. Cultures made on slightly alkaline bullock's heart medium, prepared according to the directions of Miss Muriel Robertson, produced in two or three days a considerable growth of *B. perfringens.* There was a sour smell produced in the medium, but no odour of putrefaction and none of the blackening which is almost characteristic of the presence of the bacillus of malignant œdema. The Gram-negative spore-bearer was apparently completely lost in this medium.

The points of interest in this case, apart from the fact that it occurred in a camp in this country, appear to be that the fatal issue was very rapid and that it was not till after death, twenty-four hours after the wound was inflicted, that any crepitation or other sign of gas forming organism was present in the limb. After death, however, the extension of crepitation up the limb was very rapid. There were no signs of gas in the liver or other organs, which I believe is unusual, and is possibly accounted for by the fact that the gas was carried almost direct to the heart, killing the patient before there was time for it to develop elsewhere.

I believe several cases have been described as occurring in France.

My thanks are due to Lieutenant Young, R.A.M.C., for clinical notes on this case.

Lecture.

"ON THE CIRCULATORY CHANGES ASSOCIATED WITH EXERCISE."[1]

By ERNEST H. STARLING, C.M.G., M.D., Sc.D., F.R.S.

When I was invited to take part in a series of lectures on the physiology of the soldier, it was suggested that I might take as theme for my discourse the causation of "D.A.H." Though incompetent to deal with this subject directly without a much greater experience of these cases than I possess, it seemed to me that a discussion of its physiological aspect, viz., the effective action of the heart under all the conditions of stress to which a soldier may be exposed, was a necessary preliminary to any consideration of the problems presented by defective action of this organ. Our knowledge of the circulatory reactions during muscular exercise has made considerable progress during the last decade, and indeed has not stood still even during the years of war, and no chapter in physiology can be regarded as transcending this in importance as regards the medical care of the soldier. All the training of brain, eye and hand involved in the education of the soldier is thrown away unless he is a fit animal, able to march, carry weights, endure stress, and exert, if necessary for a considerable time, all his powers, perhaps under the most adverse conditions, without breaking down temporarily or permanently. We are accustomed to associate a man's

[1] Given at the Royal Army Medical College, October 27, 1919.

fitness with his muscular system, though we are all fully aware that fitness is not dependent on muscular development, and that very often the man with small muscles and only moderate physical strength is fitter and more useful to endure the rigours of a hard fight than the man with large muscles and considerable physical powers. The latter may be useful for certain definite feats of strength, but in the power of endurance other factors are of greater importance.

For the efficient contraction of a muscle it is in the first place essential that it be well supplied with oxygen. A defective oxygen supply diminishes within seconds the contractile powers of warm-blooded muscle, and the effects of the same deficiency on the central nervous system, on which all the activity of the muscular system depends, are even more serious and more quickly brought about. As soon as the muscle enters into activity its oxygen needs become much greater. The intake of oxygen by the body as a whole is often increased five or six times over many hours, and during severe efforts the intake of oxygen and output of CO_2 may be increased ten or twelve times. Almost the whole of this increase is due to the raised requirements of the muscular system and the continued functioning of this system is impossible unless the muscle is supplied with all the oxygen that it requires. Since the oxygen is carried by the blood, and since normally the utilization of oxygen in the blood as it passes through the muscles amounts to little less than half of the total oxygen present, it is evident that there must be an increased circulation through the muscles corresponding approximately to the increased oxygen needs of the muscles. Thus the power of the muscular system to go on responding to the calls made upon it by the needs of the situation in which the individual finds himself depends on the ability of the heart to maintain this enormous increase in the circulatory rate. When a man is at the end of his strength, as it is called, and his muscles begin to fail him, it is the circulation which has failed. All the signs and symptoms of such failure are those which can be produced by oxygen lack. The weakness of the muscles and their failure to respond are due to local lack of this substance. The subjective symptoms of weakness, of dimness of vision, of incoordination, speak all of a failing supply of oxygen to the central nervous system and especially to the cerebral cortex. On this account the man who fights till he drops, or who fails in any prolonged muscular effort, presents the same symptoms as those induced in aviators and mountaineers under much smaller muscular stress but in the presence of an insufficient tension of oxygen in the air they breathe.

It is evident then that an effective action of the heart is one that maintains the circulation at such a pitch that the muscles, in spite of their increased needs, receive all the oxygen they require without lowering the quantity of this gas in the blood supplied to the brain.

Recent investigations by Krogh and his pupils in Denmark, and by American workers using Krogh's methods, have shown indeed that there is an exact parallelism between the velocity of the circulation and the oxygen needs of the body as a whole as determined by the working muscles. This is well brought out in fig. 1 which shows the results of some determinations by Means and Newburg of the total pulmonary ventilation, of the total blood flow through the heart, and of the oxygen consumption of the body under varying conditions of muscular work. It will be seen that the two lines showing the blood flow and the oxygen consumption are exactly parallel. Since during muscular exercise we

obtain this increased output of blood from the heart, and the blood-pressure against which the heart has to contract is considerably higher than normal, it must be concluded that the work of the heart is increased in still higher proportion. It is on the power of the heart to maintain this increased circulation that depends the oxygen supply to the working muscles and therefore the power of the latter to carry out their allotted task. How is this wonderful fitting of one function to another, of the activity of the contracting musculature of the heart to the varying needs of the contracting muscles effected?

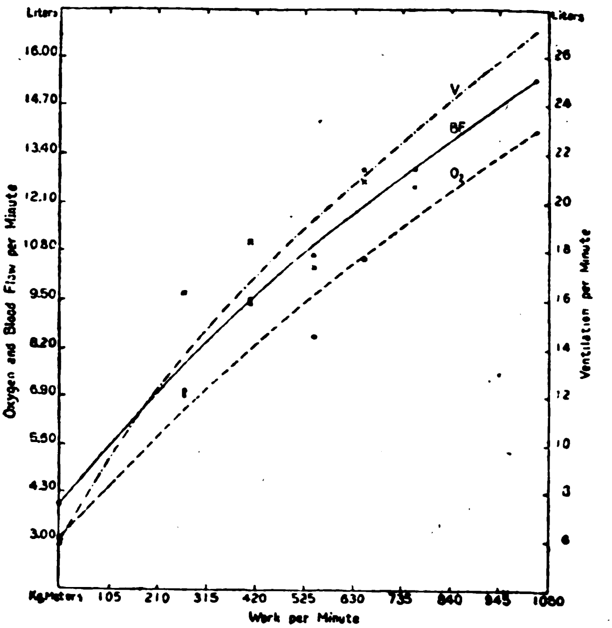


FIG. 1.—Chart showing the effect of increasing amounts of muscular work on the total ventilation of the lungs, V, on the blood flow, BF, and on the oxygen absorption, O_2. (From Means and Newburgh.)

In endeavouring to answer this question we must remember, as Haldane has so often insisted, that no organ of the body works by itself or for itself. When we speak of heart failure we must think of this organ, not as an isolated hollow mass of muscle, but as one which is brought into relation with all parts of the body and with the changes impressed on the body from without through the central nervous system. In analysing the factors involved in these complex adaptations we shall do well to start with the powers and properties of the heart itself; but we must always remember that the extraordinary powers with which the heart muscle is endowed represent but the central fortress of the system, and under normal conditions are protected and, to a large extent, prevented from coming into play by the activities of the defending positions and outposts provided by the central nervous system and its servants. It is only when these other defences fail that the heart is called upon to display those reactions which are at

once brought to light in our study of the isolated organ. But no understanding of the circulatory reactions of the body is possible unless we start first with the fundamental properties of the heart muscle itself, and then find how these are modified, protected, and controlled under the influence of the mechanisms—nervous, chemical, and mechanical—which under normal conditions play upon the heart and the blood-vessels.

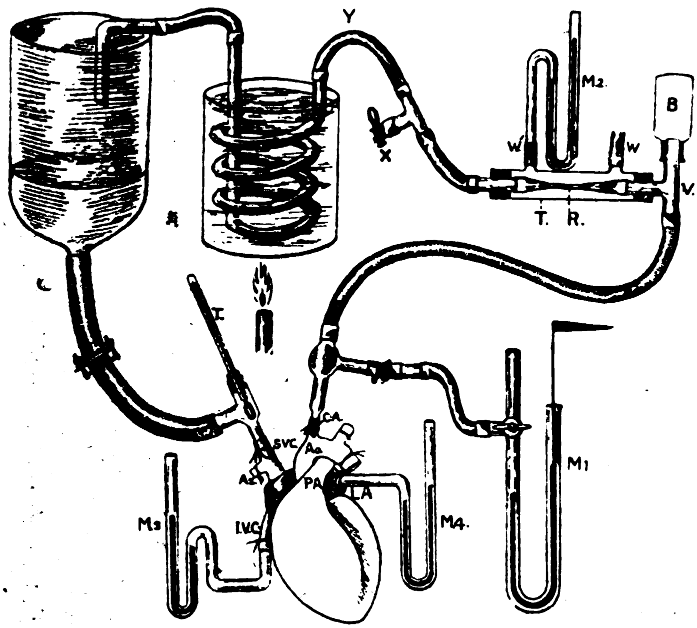


FIG. 2.—Diagram showing arrangement of heart-lung preparation. (The lungs and pump for maintaining their ventilation are not shown.) PA, pulmonary artery. LA, left auricle communicating with manometer M_4. IVC, inferior vena cava communicating with manometer M_3. Az, azygous vein tied off. SVC, superior vena cava. Ao, aorta with arterial cannula CA inserted; one branch of this cannula passes to the mercurial manometer M_1, the other branch takes the blood to the artificial circuit. B, air chamber to give resiliency to the arterial side of the circuit. R, thin rubber tube enclosed in tubular chamber T, in which air pressure can be raised to any desired height (shown by manometer M_2) by pumping in air through the tube W. X, side tube for measuring actual rate of flow from the heart. The blood passes through the spiral immersed in warm water, then into the venous reservoir, from which it is allowed to flow at any desired rate by the broad rubber tube into the superior vena cava. The thermometer T records its temperature as it enters the heart.

By means of the arrangements represented diagramatically in fig. 2, we are able to study the contractions of the heart, efficiently supplied with blood and oxygen, under all manner of conditions, when isolated from all other organs of the body except the lungs. In this 'heart-lung preparation' the temperature, the inflow of blood, and the arterial resistance to the outflow can be controlled at will, and it is easy to judge the force and time relations of the different heart activities and the pressures in the different cavities under any set of conditions we may desire. From this preparation we learn that the heart, freed from all its nervous connexions, has the power of automatically adjusting the force and extent

of its contractions to the task which is set it by the two factors determining its work, viz: the inflow into the heart from the veins, and the resistance offered to the outflow by the arterial pressure.

Let us deal with these two factors separately. In the heart-lung preparation we can alter the inflow to any extent by means of the screw clip on the tube from the venous reservoir. We find in this way that, within very wide limits, the output of the heart is changed in exact proportion. Indeed, this response of the heart is a necessary condition of the continuance of its functions. If the inflow continued greater than the output, the auricles and ventricles, at any rate on the right side, would become more and more distended until the rise of pressure in their cavities put a stop to the inflow. What one finds is that there is hardly any rise in pressure on the venous side; the blood flows into the relaxed auricle and ventricle during diastole, and is expelled from these at their next beat in proportion to the amount which has flowed in.

TABLE I.

Arterial pressure mm. Hg.	Systemic output c.c. per min.	Total coronary output (calculated)	Total output of left heart	Venous pressure cm. H_2O
84	811	40·80	851·80	9·6 — 12·4
108	790	50·30	840·30	8·8 — 12·0
140	770	70·75	840·75	8·0 — 11·2
170	750	117·40	867·40	8 0 — 10·8
208	600	260·30	860·30	12·0 — 22·0
104	760	80·30	840·00	8·4 — 10·4
104	750	80·30	830·00	8·0 — 10·0
44	790	30·40	820·00	7·6 — 10·0

The same marvellous power of adaptation is found when we oppose an increased resistance to the expulsion of blood from the left ventricle (*v.* Table I). By means of the adjustable resistance we can raise the arterial blood-pressure from, say, 80 millimetres Hg, to 200 millimetres Hg. After the first few beats, provided we maintain a constant inflow, the output remains unaltered—although the heart has to do nearly three times as much work as before in forcing this amount of blood out into the arterial system. Since the work of the heart is proportional to the arterial resistance multiplied by the output, in either of these conditions, i.e., increased output or increased arterial pressure, there is a corresponding increase in the work done by the contracting cardiac muscle. We know that when a machine, e.g., a motor cyle, meets with increased resistance, as in ascending a hill, it will slow off and stop, unless the rider opens the throttle and lets in more petrol and air, so increasing the amount of chemical change and energy available therefrom for conversion into the work of propelling the machine. In the heart, as in an ordinary machine, the increased work thrown on it by a rise of arterial pressure or an increased inflow is also met by an increase in the chemical changes of oxidation which, in all human tissues, are the ultimate sources of their available energy. In the heart-lung preparation it is easy, by analysing the air used for ventilating the lungs, to find out how much oxygen is used up, and how much carbonic acid is produced by the contracting heart muscle. The following table (Lovatt Evans) shows the result of increasing the mechanical work:—

TABLE II.—RESPIRATORY EXCHANGE OF ISOLATED HEART.

Experiment 1.—Arterial Resistance Varied: Inflow Constant.

Heart, 57 gms.

Output per hour litres	A.P. mm. Hg	O_2 per hour c.c.	Work kgm.
31	42	234	20
	130	371	60

Experiment 2.—Arterial Resistance Constant: Venous Inflow Varied.

Heart, 53 gms.

Inflow per hour litres	O_2 per hour c.c.	Heart volume	V.P. mm. H_2O	Work kgm.
13	115	0	5	12
62	331	+ 86	70	60

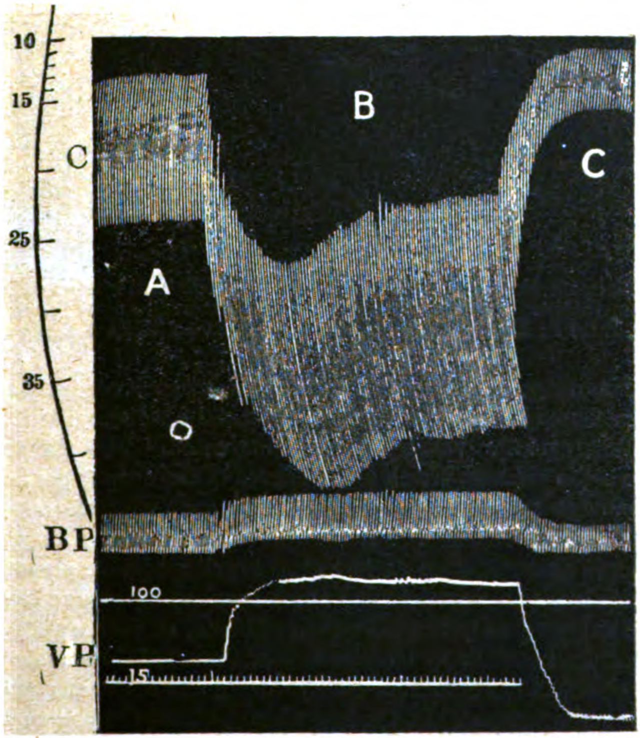


FIG. 3.—Effect of alteration in venous supply on volume of heart. Read from left to right. Dog 5·15 kilos; heart 67 grammes.

	A.R.	B.P.	V.P.	Rate	O.P.	O.P. per beat calc.	O.P. per beat observed
A.	100	124	95	22	86	3·9	5·7
B.	100	130	145	22	140	6·4	8·0
C.	100	122	55	22	30	1·5	2·5

We see that the oxygen consumption is increased in almost direct ratio to the increased work thrown on the heart. But there is no rider to open the throttle and increase the chemical changes which shall give rise to the energy available for muscular work. The adaptation of the heart to the increased demands upon it must be automatic, and the self-governing mechanism in our preparation must be sought in the cardiac muscle itself. A clue to the understanding of the mechanism of this automatic adaptation is afforded by a study of the volume changes of the heart under varying conditions of inflow and of arterial resistance. If we enclose the heart in a cardiometer connected with an appropriate piston recorder, we obtain a tracing, such as that in fig. 3, of the change

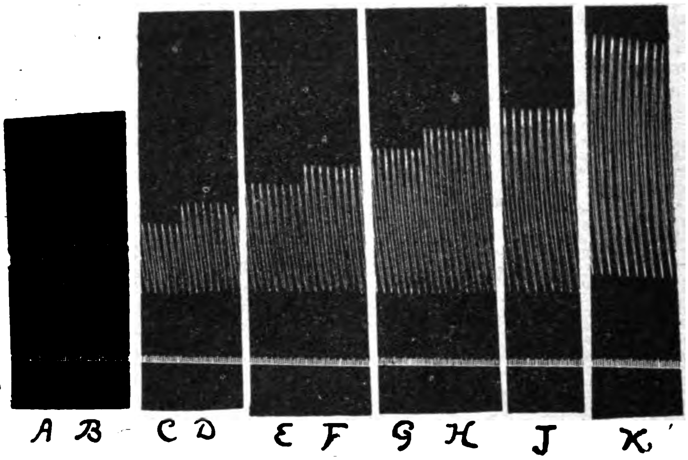


FIG. 4.—Cardiometer tracings of tortoise heart with different venous filling, the arterial resistance being maintained constant. Height of venous reservoir above heart, A, 2·0; B, 4·8; C, 7·6; D, 10·4; E, 13·2; F. 16·0; G, 18·8; H, 21·6; J, 24·4; K, 34·4 centimetres.

in volume in this organ, or of the ventricles alone, at each contraction. As might be imagined, increased inflow causes a rise of diastolic volume, but reference to the figure shows that systolic volume is also increased. The difference between diastolic and systolic volume, which is a measure of the output per beat, is exactly equal to the change in volume occurring during each diastole and proportional to the diastolic inflow. Since the heart has to drive out a larger amount of blood in the same space of time as it had to expel a smaller amount, the difference of pressure between ventricle and aorta must be correspondingly greater to impart the necessary velocity to the column of blood, so that, even if we maintain the arterial pressure constant by modification of the arterial resistance, there must be a higher tension in the ventricular cavity during and at the end of the beat than there is with a smaller output. In the frog's heart, where the contraction is slower and the velocity of the outflowing fluid almost negligible, increased inflow merely increases the diastolic volume (see fig. 4). The increased systolic volume in the mammalian heart with augmentation of inflow must therefore be related to the higher tension in this cavity during and towards the end of systole. That this is the case is shown by a study of the effects on the heart volume of increasing the arterial resistance, shown in fig. 5. Here it will be seen that the immediate effect of a rise

of arterial pressure is a partial failure of the heart. The ventricle does not put out as much blood as it receives, so that the residual blood at the end of systole, and therewith the systolic volume of the ventricle, is increased. But with every succeeding beat it will be seen that this failure becomes less, until after about half a dozen beats the excursion of the lever which measures the output of the ventricles becomes equal to that obtaining at the lower arterial resistance. Now the heart is throwing out at each systole all the blood it receives during the preceding diastole, though to do this it has to raise the pressure in its cavities to a height

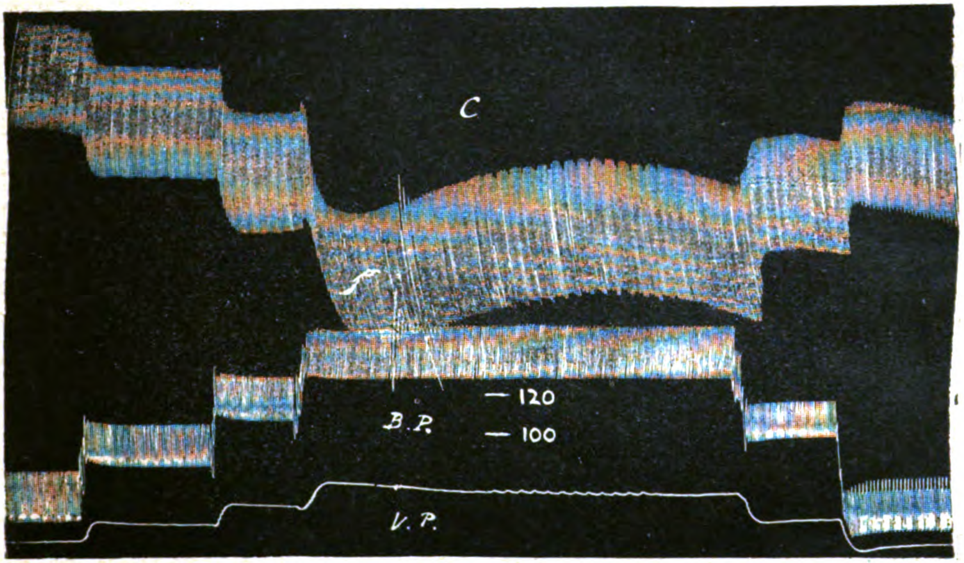


FIG. 5.—Effect of raising and lowering the arterial resistance on the volume and output of the ventricles.

T.	A.R.	B.P.	V.P.	Rate	O.P. 10″	O.P. per beat calc.	O.P. per beat observed
35° C.	40	70	85	23	110	4·8	6·0
35	66	95	105	—	—	—	6·75
35	98	118	120	—	—	—	6·75
35	116	142	138	—	—	—	7·0
35	70	105	103	—	—	—	6·0
35	28	58	75	—	—	—	5·75

two or three times as great as that attained with a low arterial resistance. With a healthy heart, and changes in the arterial resistance confined to what we may term physiological limits, there is no alteration in the tension of the heart fibres—i.e., in the pressure within the ventricular cavities at the end of diastole. The results of exceeding these limits is shown in fig. 6. The sole factor, therefore, in determining the increase in contractile stress set up by each muscle fibre must be the greater dilatation of the ventricles—i.e., the greater length of each muscle fibre. The behaviour of the muscle tissue of the heart thus resembles that of muscular tissue generally, whether skeletal or unstriated, in which the contractile stress set up by each contraction is a function of the length of the fibre. The

greater the length of the fibre, and therefore the greater amount of surface of its longitudinal contractile elements at the moment when it begins to contract, the greater will be the energy in the form of contractile stress set up in its contraction, and the more extensive will be the chemical changes involved. This relation between the length of the heart fibre and its power of contraction I have called "the law of the heart."

FIG. 6.—Volume changes of the heart with a big inflow when the arterial pressure was raised to a height too great for the capacity of the heart.

T.	A.R.	B.P.	V.P.	Rate	O.P. 10″	O.P. per beat calc.	O.P. per beat observed
35° C.	60	95	120	23	154	6·7	9·5
35	96	126	145	23	—	—	9·5
25	144	170	200	23	—	—	9·0

Before passing on, I may call your attention to one feature in the curve in fig. 5, showing the effects of rise of arterial resistance, which throws light on a subsidiary adaptation of the heart. It will be noted that, though the inflow and arterial resistance remain constant, the systolic volume diminishes somewhat after its initial increase. This is due to the facts that, in the first place, the circulation through the coronary vessels is directly proportional to the arterial blood pressure, and, in the second place, any increased work of the heart muscle gives rise to the production of metabolites, which actively dilate the coronary vessels

and so increase the blood flow through them. Under the influence of these two factors the heart muscle becomes more rapidly supplied with oxygen than before, its physiological condition is improved, and therewith the amount of energy it evolves on entering into contraction from any given initial length. A good heart will produce a given pressure within its cavities, when it contracts, with a smaller total volume or degree of dilatation than will a heart in poor condition. The nutrition of the heart, therefore, is a potent influence in determining the degree to which the heart must dilate in order to overcome any given resistance or to throw out any given volume of blood.

Now let us see how such an isolated heart depending only on its self-governing mechanisms will behave under the conditions which arise in muscular exercise. It is often forgotten how the circulation through the peripheral parts of the body is dependent on muscular contraction. Thus Hill has shown that in the man standing upright, the pressure in the capillaries of the foot is not appreciably higher than the pressure in the capillaries of the hand, although the blood has to be returned from the foot capillaries to the heart against the hydrostatic pressure of the column of blood between foot and heart. This pressure, however, does not fall on the capillaries. Every unconscious slight movement of the leg and trunk muscles presses on the blood in the veins and, in virtue of the valves in these vessels, drives the blood on towards the heart. During exercise involving rapid contractions of a vast number of muscles this accessory pumping action must be equal to or transcend in importance the action of the heart itself, and is at any rate responsible for the returning of the blood from the capillaries to the heart. Every muscular action will therefore send back blood to the heart, and, during exercise, there will be an increased flow of blood towards the heart in proportion to the severity of the exercise. The effect will be the same as if, in our heart-lung preparation, we released the clip of the tube of the venous reservoir. The inflow is increased, and the ventricles dilate until they are capable of sending out into the arterial system the whole of the blood that they receive. Unless there is a widespread dilatation of the arterioles and therewith a diminution of arterial resistance, the arterial pressure will also rise and thus we have all the factors for driving an increased amount of blood through the contracting muscles.

Such a nerveless system, though admirable in its powers of adaptation, would not be economic. The heart freed from nervous control beats in the dog at about double (120 to 140) the rate obtaining in the normal animal. Its rate is unaltered by mechanical conditions and is determined solely by the temperature of the pacemaker in the auricles. On investigating the amount of chemical energy required to keep this heart going, it is found that, whereas the mechanical efficiency of a man's muscles are something between twenty per cent and thirty per cent, the isolated heart, when throwing out its resting load of blood, only converts about five per cent of the chemical energy expended into the production of mechanical work. As we increase the load on the heart by raising the inflow, the mechanical efficiency rises until, with a maximum inflow corresponding to the output of the animal's heart during severe muscular exercise, as much as twenty-eight per cent of the total energy set free in the heart muscle may be utilized for driving on the blood and maintaining the circulation.

A further increase of output is rendered impossible by the action of the

pericardium, which prevents any greater dilatation of the heart cavities in diastole. After this limit has been reached, increased inflow simply raises the pressure within the auricles and ventricles at the end of diastole without increasing their volume or causing any augmentation in the strength of their contraction or in the output of the heart. The important function of the pericardium in protecting the heart from over-distension and excessive calls on its powers of contraction is shown if, with a maximum inflow the pericardium be widely opened. The pressure within the cavities at the end of diastole falls, while the output can be still further increased, i.e., above the maximum possible with an intact pericardium. But allow this to go on for a few minutes and then examine the heart. It will be found that the heart has responded to this supreme call but to its own destruction. On cutting into the ventricular walls these are found studded with little hæmorrhages. The fibres have contracted with such force that they have in many places undergone rupture and there can be little doubt that if it had been possible for the animal to survive, such hæmorrhages would have given place to fibroid patches with marked impairment of the heart muscle as a result.

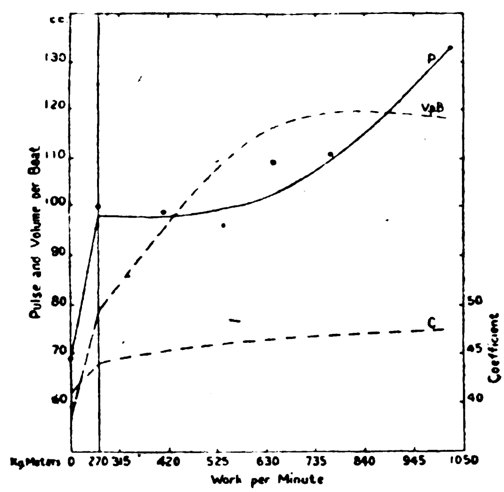


FIG 7.—Chart showing the effect of increasing amounts of muscular work on the pulse-rate P (shown by dots) on the heart output per beat, VpB, and on the co-efficient of oxygen utilization in the blood, C. (From Means and Newburgh.)

Let us now imagine the central nervous system and heart nerves replaced in this simple muscle-heart-lung system. The immediate effect will be a diminution of the rate of the heart, which will come under the tonic action of the vagus, so that it will beat at a rate of seventy instead of 140 per minute. Since the expenditure of energy by the heart is, other things equal, proportional to the number of beats, this reining in of the heart's activity will at once diminish its expenditure by one half, and so will double its efficiency and save it from fatigue in like proportion. We can study how this more complex mechanism will behave under muscular exercise on the intact man. It will be seen from fig. 7 that muscular exercise causes an increased output per beat, but also an increased pulse rate.

These two changes are not synchronous. The first change which occurs is an increased output per beat without much alteration in the pulse-rate. The mechanism of this increased output is that which we have studied in the nerveless heart of the heart-lung preparation, increased filling evoking an increased contraction and output. This process goes on until the inflow into the heart proceeds steadily throughout the whole of diastole, and the heart just before systole just fills the pericardium. Then comes in a second process. Any further increase of inflow can only occur by distending the heart and causing a rise of the pressure within its cavities, which up to this point can be regarded as practically zero throughout the whole of diastole. Bainbridge has shown that any rise of pressure in the auricles or on the venous side of the heart brings into play a reflex which, I think, should be designated the Bainbridge reflex, to distinguish it from the well known Marey reflex or Marey's law, according to which the heart is slowed reflexly by a rise of pressure in the ventricular cavities during systole. But a rise of pressure on the venous side during diastole has a reverse effect. It causes a reflex quickening of the heart, chiefly by inhibition of the vagus tone, but partly also in all probability by a reflex excitation of the accelerator mechanism. The result is a calling of the heart to an increased output per minute and a lowering of the distension on the venous side. With increasing inflow this reflex acceleration progresses, until finally the heart is beating with maximum force and at maximum rate and the conditions are reproduced which we find in the heart-lung preparation. A six-fold increase in the output of the heart is thus easily effected, and in good hearts, such as those of athletes, the increase may be as much as ten times for a short duration of time.

But this by no means exhausts the forces which, in the intact animal, are brought into play for enabling the circulation to cope with the exigencies of the animal's environment. As Cannon has shown, in emotional stress (and what supreme effort is free from such stress) there is an increased discharge of adrenaline from the suprarenal bodies. Almost every action of this almost universal hormone is directed to maintaining the conditions which are necessary for the optimum performance of the neuro-muscular system. On the heart the adrenaline acts by exciting the accelerator mechanism; not only is the rate of the heart still further increased, but the energy available at each contraction is markedly augmented. Take a heart in the heart-lung preparation which is beginning to fail with a maximum inflow. A minute trace of adrenaline introduced into the circulation causes at once a quickening of beat, the venous pressure falls, and the ventricles empty themselves at each contraction so completely that although the inflow is unaltered, both systolic and diastolic volumes are diminished. Under these circumstances the drug-like influence of adrenaline is too apparent. It will stimulate the heart to its maximum effort and thus tide it over the supreme moment of a struggle to the death, but it is especially under suchconditions that one finds at the end of the experiment the heart muscle torn and interspersed with minute hæmorrhages. After such a struggle, the animal, though perhaps surviving the combat, may never be the same again.

But, short of such an over-stimulation, adrenaline has other effects which aid the circulation through the muscles. In opposition to its action on most vessels, adrenaline causes dilatation of the coronary arteries, and therefore increased blood-flow and oxygen supply to the labouring heart-muscle. Its vaso-

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constrictor effect is chiefly spent on the splanchnic area, so that the vessels here are contracted, enabling all the available blood to be diverted to the muscular system. At the same time it acts on the liver, mobilising the sugar reserve of this organ and providing the muscles with the food that can serve them best as a source of energy in their time of need.

In studying the reactions of the isolated heart, dilatation of the heart seems to be the only mechanism of the unfailing response of this organ to any increase in the demands made upon it. But the effect of throwing this organ into the circle of control by the central nervous system is that it is kept in rest or activity in an equable condition, and the dilatation, which was so marked a condition of its reaction when isolated, is reduced to such small dimensions in the heart reined in and controlled by the cardiac centres, and helped by the correlated changes in other organs, that it becomes imperceptible in the intact animal, and is not revealed, for instance, by any radiographic study of the heart during exercise.

The whole purpose of the phenomena that I have described to you is that the muscles shall be effectively supplied with blood for the transport of the oxygen that they require. To this end changes are brought about in the circulation through the muscles by local events hardly inferior in importance to those occurring in the central pump. Not only is there a dilatation of the arterioles and arteries supplying the muscles, but, as Krogh has shown, there is an active dilatation of all the capillaries. Many new capillaries come into view which in the resting muscle are empty, and so marked are these changes that, according to Krogh, the total volume of the capillaries in the contracting muscle may be 500 times as great as that in the resting muscle. By this dilatation and increase in number and calibre of the capillaries, every contracting unit comes into close proximity to a rapid flow of blood, so that the tension of oxygen in the interior of the muscle fibre itself is very little below that of the blood circulating in the capillaries. This dilatation of arterioles and capillaries is probably brought about by the action of metabolites produced in the contracting muscle itself. Among these metabolites are acid products, carbonic acid and lactic acid. As Barcroft has shown, the access of these bodies to the blood, and the slight diminution of alkalinity thereby effected, alters the curve of dissociation of the oxyhæmaglobin, so that this gives off its oxygen with greater ease to supply the needs of the muscle fibres. Thus the increased circulation through the heart muscles is associated with an increased utilization of the oxygen of the blood, so that this returns to the heart having lost perhaps 50 or 60 per cent of its oxygen, as against 40 or 50 per cent in normal conditions. These effects are shown in fig. 1.

So far I have described a number of reflex mechanisms which co-operate for the maintenance of the circulation in an animal during muscular effort. All this might be brought about in an animal deprived of its cortex. On the top of these, we must imagine the cortex, with its multifarious activities, taking charge of, initiating and controlling the reflex mechanisms we have studied. The part played by the higher centres is brought out in the curves 1 and 2, and every act of volition, the mere intention, or attention with reference to a willed effort, involves changes in the heart, respiration and circulation, anticipatory of and of a similar character to those which will be excited by the muscular activity itself. In the experiment on man I have quoted, it is only necessary to set him on the stationary bicycle on which he is going to work, to evoke increased respiration, pulse-rate

and blood pressure. At the word, "Are you ready?" a further increase will be apparent, and at the word "Go!" all these processes will be quickened before the reflex mechanisms I have described can be brought into play, so that there can be no lack in the supply of oxygen and blood to the working tissues. Any emotional colour, such as that supplied by desire or by fear, will at the same time release a certain amount of adrenaline, so that the heart may be somewhat ahead of the strain which will be thrown upon it by the increased inflow from the contracting muscles.

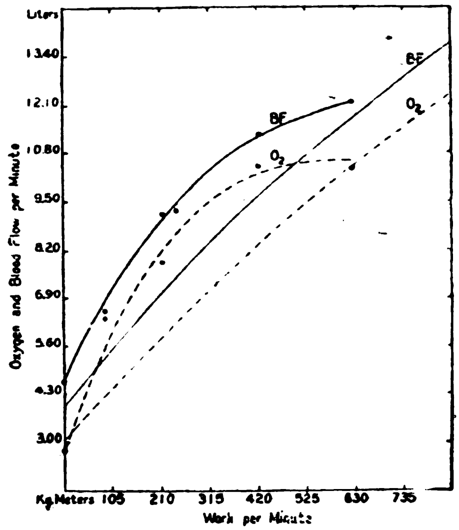


FIG. 8.—Chart showing the effects of muscular work on the blood flow and oxygen consumption in a subject with aortic disease, as compared with a normal individual (shown in lighter lines.) (From Means and Newburgh.) For oxygen consumption omit the decimal point and read in cubic centimetres.

The total results of these processes is a perfection of adaptation, an absolute parallelism of the circulation to the oxygen consumption such as we have seen in the results depicted in my first diagram. But this applies to a healthy man. What will be the case in disease? As we have seen, even the healthy heart can be forced to a degree under which it succumbs. It can put out six to ten times more blood than under normal resting conditions, but these figures represent its limit or margin. Disease, as Lewis has shown, consists merely in a diminution of this margin and becomes apparent and a burden to the individual when the diminution is so marked that it interferes with his normal functions. It is evident that, in the case of the soldier, any diminution below the average can be looked upon as a deficiency or a disease, because unfitting the soldier for the supreme effort demanded in combat. The effect of this diminution in margin of resistance is well shown in the different curves in fig. 8, representing the results of estimations made by Means and Newburgh on the response to muscular effort in a patient suffering from aortic and mitral disease, but in a condition which may be regarded as good compensation. This man could carry out his normal work and earn his daily bread without difficulty, but it will be seen that not only did an

increased demand involve a greater effort on the part of his heart and circulation, but the adaptation ceased altogether and the circulation began to lag behind the requirements made upon it much earlier than is the case in the normal individual.

D.A.H. is a diminution of this margin; sometimes it may be due, as in the case just quoted, to actual disease, sometimes to ill-developed musculature and possibly to deficient development of the coronary system. In other cases there may be actually an over-activity or over-sensibility of the central nervous mechanisms, especially those connected with the cortex cerebri, which I have compared to the trench systems and outposts protecting the citadal of the circulation, the heart, from direct assault. Jumpy sentries may give rise to excessive reactions on the part of a whole army and it seems possible that such "jumpiness" or asthenic irritability of the central nervous system may be responsible for the exaggeration that is observed in these cases of reaction to exercise. Any such over-action, as we have seen, is uneconomical; the mechanical efficiency of a heart contracting too rapidly is bad and such over-action must lead to speedy exhaustion and to the effects with which you are already familiar. But I am not competent to discuss the causes of D.A.H. I have tried to give you an account of the complex of reactions which are essential for the carrying out of muscular efforts in the healthy man. I must leave it to you, with your greater experience and opportunities, to determine to what extent any of these are involved in the disturbance of the effort syndrome typical of disordered action of the heart.

Report.

REPORT OF A COMMITTEE OF INQUIRY REGARDING THE PREVALENCE OF PELLAGRA AMONG TURKISH PRISONERS OF WAR.

(*Continued from p.* 184.)

(*b*) Investigations of Assimilation Efficiency.

(1) *At Heliopolis Non-Labour Camp.*

The objects of this experiment were as follows:—

(*a*) By comparison of the fæcal and urinary nitrogen, to determine the relative percentages of protein lost by non-absorption in two groups of (i) healthy and (ii) pellagrous prisoners of war receiving identical diets.

(*b*) By comparing the nitrogen intake with the urinary and fæcal nitrogen excreted by the healthy group, to estimate the availability (per cent absorption) of the protein of the prisoners of war rations as issued to non-labour prisoners.

Two groups of five men each were placed in a separate enclosure, under the charge of a serjeant and two orderlies—day and night. The men were for two days, before the collection of samples began, living under the conditions of the experiment. Their weights were taken daily, and careful supervision was maintained over practice in the collection and measurement of excreta by the orderlies.

The fæces and urine, pooled for each group, were collected separately and a

daily analysis was made of the urine and fæces for each group. The average amounts per man were calculated from these daily analyses.

The food was that ordinarily consumed in the camp, but was issued by weight direct from bulk in the Q.M. stores and was cooked in a separate kitchen for the two groups together. The conditions of the experiment did not admit of complete supervision of the issues from stores nor of the actual cooking, nor was it possible under the circumstances to obtain daily samples of rations corresponding to those issued to the subjects of the experiment; but samples were taken from the Q.M. stores on the day before the experiment began. The amount of food left over was carefully recorded.

Daily averages per man. (*See* Table I for details.)

	Pellagrous	Non-pellagrous
(a) *Fæces.*		
Characters of	Liquid and offensive	Semi-solid
Daily number of motions ..	4·5	2·0
Total weight	540 grm.	473 grm.
Total solids—weight ..	68 ,,	94 ,,
,, ,, per cent ..	12·5	19·7
(b) *Urine.*		
Volume	971 c.c.	1502 c.c.
Specific gravity	1011 to 1019	1014 to 1018
Reaction	Acid	Acid
Albumin	*Nil*	*Nil*
Sugar	*Nil*	*Nil*
Indican	Present	Absent
(c) *Nitrogen.*		
Fæces	3·41 grm. = 35.1 per cent	4·33 grm. = 33·6 per cent
Urine	6·30 ,, = 64·9 ,,	8·52 ,, = 66·3 ,,
Per cent loss in intestines ..	9·71 100·0 per cent	12·85 99·9 per cent
(d) *Fat.*		
Unassimilated	6·2 grm.	5·3 grm.
Per cent loss on intake ..	28·2 ,,	19·5 per cent
(e) *Unconsumed Food.*		
Weight of protein	12 grm.	*Nil*
Weight of fat	5 ,,	*Nil*
(f) *Weights of Patients.*		
Body weight	Slight increase	Slight loss

The sequence of events consequent on lack of gastric acid is: Deficient pancreatic digestion; passage of undigested protein into the large intestine; bacterial putrefaction in that protein, leading to its destruction. The loss of protein and especially of fat, even in the non-pellagrous, is obviously of extreme importance. Whether the digestive failure is due to pellagra, or the reverse, remains undetermined—but in either case the stage of mal-absorption is regarded as being antecedent to development of clinical pellagra.

It is to be noted that *indican* was present in the pellagrins' urine. This substance is derived from the important amino-acid tryptophane of the protein molecule. On being broken up by intestinal putrefaction, tryptophane is converted into indol, which is absorbed and excreted in the urine as the potassium salt of indoxyl-sulphonic acid. The indican is evidence of the destruction not only of

tryptophane but of the whole protein molecule, and thus of complete loss to the organism of an amount of protein corresponding to the amount of indican present in the urine. With a diet of the composition of the rations consumed by these men, the amount of indican present in the urine may, when a large quantity of this substance is present. represent a daily loss to the organism of as much as twenty grammes of protein. This amount ought probably to be deducted from the metabolized nitrogen as indicated by the nitrogen of the urine; whether this latter suggestion is justified or not, the presence of indican implies that the figure of 35·1 per cent loss of protein in the alimentary tract represents only a part of the actual loss.

Perhaps the most important result of the experiment is to show that the percentage loss of ration protein in the intestines of healthy prisoners of war amounted to approximately one-third of the protein intake, instead of about twenty-three per cent as estimated from previous knowledge. This means that whereas the Turkish prisoner of war (non-labour) diet, containing 91 grammes of gross protein, is assumed to give 68 grammes of protein available for nutrition, it actually yields no more than 60 grammes. The biological value of the daily protein intake is thus reduced from about 38 to 33 grammes.

The cause of this defective absorption, as demonstrated by the results of the healthy group, is almost certainly to be ascribed to the insufficient aeration and indigestible character of the bread and to the fact that the bean ration was not softened to a proper extent by preliminary soaking in cold water and subsequent boiling. A sample of stew inspected was found to contain beans which were quite insufficiently cooked.

Conclusions.

From this experiment it is evident that, as compared with non-pellagrous, the pellagrous prisoners suffered from deficiency of food by :—

(*a*) Lack of appetite.
(*b*) Mal-absorption of protein and fat.
(*c*) Destruction of protein by bacterial putrefaction as shown by indicanuria.

(2) *At East Kantara Labour Camp.*
(*See* Table II for details.)

The objects were similar to those enumerated.

Five prisoners, selected as showing no signs of disease, were observed for nine days, with a previous two days of probation before the collection of excreta began.

That they were not pellagrous was borne out by the fact that the urine in no case contained indican.

In this experiment the urine of each individual was collected separately and analysed daily, the fæces not being collected.

The men being healthy and all living on ordinary camp diet under similar conditions, it was expected to find a general agreement in the quantity of metabolized nitrogen—as estimated from the urine. By adding to this the factor of fifty per cent for fæcal loss, as observed at Heliopolis, it was further anticipated that the total would approximately equal the presumed nitrogen intake as known from the composition of the ration. Considerable variation was, however, observed and in

no case did the total output, as estimated on the above basis, reach in any individual the presumed protein content of the ration.

The men were taken off labour and segregated in the hospital compound, the rations being drawn in the usual way from the camp kitchen of one compound.

The weighing of the subjects of the experiment could not be satisfactorily carried out; it is therefore impossible to say to what extent storage of protein affected the results.

Under these conditions we were prepared to expect that, for the first six days, a positive nitrogen equilibrium may have existed; but it might have been expected that for the last four days of the experiment, nitrogen equilibrium, at any rate in some of the subjects, would have been established. Even, however, in the cases in which there is little doubt that no loss of urine could have occurred, the same irregularity and deficiency below the expected output was still observable.

A graphic representation of the results for each individual and the average for five men show the above stated facts (Graph 9).

On November 17, an analysis of the complete ration for five men was made, and showed a mean amount of protein for each man up to 99 grammes. The maximum output, estimated from the urinary nitrogen plus 50 per cent showed in one case (No. 5) an output approximating to the above amount, namely 96 grammes in the twenty-four hours. In the four other men the estimated output (on presumed intake) was considerably less than this. It is to be noted that the rations analysed were not from the same compound kitchen as that supplying the experimental group.

Conclusions.

The following are the *Conclusions* drawn from the experiment :—

(*a*) That the percentage absorption of protein from the intestine was even less than 67 per cent : that in fact the availability of the protein was considerably smaller than that observed at Heliopolis.

In view of the inferior quality of the bread, this is probable.

(*b*) That unexplained variations occurred in the quantity or composition of the rations supplied.

(*c*) That the diet was of a monotonous character : exactly the same type of food, bread and stew (consisting of meat, beans, rice and onions) was supplied on eight days out of nine, the only variation being that on one day the stew contained no beans.

General Conclusions.

(1) That the food supplied is of fair average quality.

(2) That the metabolism of the Turkish prisoners of war is characterized by a low degree of assimilation of nitrogen and of fat, as shown by the following comparisons :—

Nitrogen		Fat	
67 per cent	.. ..	80 per cent	for Turkish prisoners.
77 ,,	.. ..	90 ,,	for Egyption convicts on a similar diet.
90 ,,	.. ..	95 ,,	for normal persons on a diet rich in animal protein.

(3) That, consequently, an otherwise apparently adequate diet may prove inadequate when corrected for this defective assimilation.

The tabular summary of ration values of the various scales and dietaries is attached (Table III).

We have to thank Dr. Abd el Maghid Bey Mahmoud (Assistant Professor) and Mr. King (head laboratory attendant) of Kasr el Aini Medical School, for their help in this work.

(*Signed*) W. H. WILSON,
P. S. LELEAN, *Lieut.-Colonel, R.A.M.C.*
H. E. ROAF, *Captain, R.A.M.C.(T.).*

TABLE I.—HELIOPOLIS EXPERIMENTS.

Two groups: A. Pellagrous. B. Healthy. (Five men in each.)
Observed for seven days; results of last five days.

Day of experiment:	3rd	4th	5th	6th	7th
Group A, Pellagrous—					
Total N of urine as protein + 3	38·75	38·75	39·5	37·5	40·7
,, fæces ,, − 3	25·10	25·60	20·0	13·6	26·2
Total intake as protein	63·85	64·35	59·5	51·1	66·9
Per cent loss in fæces	38·60	40·00	33·6	28·8	38·8
Group B, Healthy—					
Total N of urine as protein + 3	50	55·9	57·9	39·75	65·6
,, fæces ,, − 3	22·9	35·6	21·3	16·80	37·5
Total intake as protein	72·9	91·5	79·2	56·55	103·1
Per cent loss in fæces	31·5	39·2	26·9	29·9	36·3
Nature of evening meal on day before collecting excreta = bread + stew	Stew of meat, rice, onions	Beans, rice, onions	Meat, rice, onions	Beans rice, onions	Beans, rice, onions

TABLE II.—KANTARA EXPERIMENT.

Five men under observation for eleven days. Total N of urine.
Details for last five days.

Subject	Day of experiment	7th	8th	9th	10th	11th	Mean of five days
1	Volume of urine	22·80	15·30	20·23	18·24	22·40	
	Equivalent in protein of N + 3*	53·30	49·50	63·90	59·30	56·70	56·5
	Assumed protein intake†	79 80	74·80	95·00	89·00	85·00	84·7
2	Volume of urine	11·97	94·00	11·68	11·40	14·74	
	Equivalent in protein of N + 3	65·50	58·10	64·30	63·60	64·50	63·2
	Assumed protein intake	98·50	87·00	96·40	95·30	96·70	94·8
3	Volume of urine	94·00	73·10	85·50	11·97	11·12	
	Equivalent in protein of N + 3	67·20	45·80	56·30	54·70	51·00	55·0
	Assumed protein intake	100·80	68·70	94·40	82·00	76·50	82·5
4	Volume of urine	12·82	94·00	91·50	91·50	10·84	
	Equivalent in protein of N + 3	49·00	45·40	54·70	50·60	53·60	50·8
	Assumed protein intake	73·50	68·10	82·00	75·90	80·00	76·2
5	Volume of urine	12·54	14·53	11·10	12·82	11·40	
	Equivalent in protein of N + 3	70·40	63·50	61·10	58·00	60·90	62·8
	Assumed protein intake	105·60	95·30	91·60	87·00	91·40	94·2
	Daily average of five men						
	Equivalent in protein of N + 3	61·20	52·40	60·00	57·20	57·30	57·6
	Assumed protein intake	91·50	78 60	90·00	85·70	85·70	86·4

* = Equivalent of total urinary nitrogen + 3 = equivalent of metabolized N of fæces.

† = Total metabolized N assumed to represent 67 per cent of protein intake; 33 per cent of intake assumed to be unabsorbed and lost in fæces.

TABLE III.—SUMMARY OF RATION VALUES.

Date	**Turkish Troops, before capture.**	Grm.	Protein: Biological value	Protein: Gross	Fat	Carbohyd.	Calories
9.9.17	(a) *Troops on Sinai Front.*						
	Bread (wheat, barley, maize) ..	680	12·9	50·3	12·24	328	1,666
	Meat (net)	40	7·6	8·0	2·00	—	51
	Bulgur (prepared wheat) ..	150	5·4	18·0	2·50	94	484
	Oil	10	—	—	10·00	—	93
	Vegetables (mostly onions) ..	30	0·2	0·4	0·10	3	16
	Dates	15	0·1	0·3	0·40	12	49
	Rice	70	4·2	5·4	0·28	53	244
	Totals ..		30·4	82·4	27·52	490	2,603
Sept., 1918	(b) *Troops in Palestine.*						
	(1) 1st line ration.						
	Bread	680	12·9	50·3	12·24	328	1,666
	Meat	13	2·4	2·5	0·60	—	16
	Oil	10	—	—	10·00	—	93
	Bulgur	150	5·4	18·0	2·50	95	485
	Dates	33	0·3	0·7	0·80	25	113
	Totals ..		21·0	71·5	26·14	448	2,372
,,	(2) Average, three armies, 1st line ..		42·8	82·7	41·20	311	1,987
,,	(3) Average, 2nd line		40·9	80·7	41·03	348	2,135
,,	(4) Line of communication ration ..		36·2	93·0	45·40	474	2,746
,,	(5) Various diets, 1st line		37·5	96·2	35·90	428	2,475
			25·8	84·0	12·20	460	2,333
			32·0	74·0	22·00	332	1,869
			44·4	81·0	25·00	333	1,930
Aug. to Nov., 1918	(6) Units of 27th Division.						
	Regiment 67, Battalion 2 ..		..	..	..	..	2,475
	,, 67 ,, 3 ..		..	..	..	..	2,952
	,, 79 ,, 4 ..		..	..	..	..	2,615
	,, 80 ,, 4 ..		..	..	..	..	2,527
	,, 81 ,, 1 ..		..	..	..	..	2,715
	,, 81 ,, 3 ..		..	..	..	..	2,641
	,, 81 ,, 4 ..		..	..	..	..	2,569
	,, 163 ,, 1 ..		..	..	..	..	2,418
	,, 163 ,, 2 ..		..	..	..	..	2,838
	,, 163 ,, 3 ..		..	..	..	..	2,418
	,, 13, 1st Field Artillery		..	..	..	..	2,591
	,, 43 ,, ,,		..	..	..	..	2,214
			Average of above			..	2,606
	Turkish Prisoners of War.						
	(a) *Labour.*						
2.1.17	(1) G.R.O. 2418		39·2	92·2	29·60	514	2,760
3.3.18	(2) G.R.O. 3619						
	Bread (10 per cent millet)	910	18·2	63·7	9·10	432	2,120
	Meat (net)	91	17·3	18·2	13·80	—	203
	Vegetables (mixed, fresh)	114	0·5	1·5	—	4	20
	Rice	85	5·1	6·5	0·34	65	295
	Oil (cotton-seed) ..	14	—	—	14·20	—	132
	Onions	14	0·1	0·2	0·04	2	7
	Sugar	28	—	—	—	26	117
	Dates (or olives) ..	57	0·5	1·2	1·42	43	194
	Lentils (or beans) ..	65	7·0	18·0	1·30	36	232
	Totals ..		48·7	119·3	40·02	610	3,323
	Actual issues, Kantara, June to October		45·6	102·4	33·33	560	3,026
	Amount assimilated		39·1				

SUMMARY OF RATION VALUES—*Continued.*

Date		Grm.	Protein: Biological value	Protein: Gross	Fat.	Carbohyd.	Calories
16.11.18	(3) G.R.O. 4653 as amended.						
	Bread (all wheat) ..	910	18·2	63·7	9·10	432	2,120
	Meat (net)	91	17·3	18·2	13·80	—	213
	Vegetables (mixed, fresh)	114	0·5	1·5	—	4	20
	Rice	85	5·1	6·5	0·34	65	295
	Oil (or margarine) ..	21½	—	—	21·30	—	198
	Onions..	14	0·1	0·2	0·04	2	7
	Sugar	28½	—	—	—	28	117
	Dates (or olives) ..	57	0·5	1·2	1·32	43	194
	Lentils	114	11·7	30·4	2·3	62	396
	Totals	..	53·8	122·6	48 30	637	3,512
	(b) *Non-Labour.*						
Feb., 1915	(1) Contract		50·0	113·0	31·00	576	3,115
18.10.15	(2) G R.O. 567		63·2	104·3	10·20	546	2,840
31.1.16	(3) Contract		51·1	94·1	25·45	486	2,608
1.5.17	(4) G.R.O. 2418.						
	Bread (10 per cent millet)	780	15·6	54·6	7·80	370	1,810
	Meat (net)	25	4·7	5·0	1·20	—	32
	Vegetables (fresh, mixed)	140	0·7	1·7	—	4	26
	Rice	95	5·6	7·2	0·40	71	326
	Oil (cotton-seed) ..	15½	—	—	15 50	—	144
	Onions	15½	0·1	0·2	0·50	2	10
	Sugar	14	—	—	—	14	57
	Cheese (native skim-milk)	26½	5·6	5·8	0·30	—	27
	Dates (or olives) ..	26½	0·2	0·5	0·65	20	88
	Lentils (or beans) ..	62	6·6	17·0	1·20	34	221
	Totals	..	39·1	92·0	27·55	515	2,744
	Olives in lieu of dates ..	..	39·0	94·0	32·45	497	2,724
	Actual issues on above G.R.O. 1.4.18 to 26.9.18	..	37·2	90·5	30·75	492	2,684
16.11.18	(5) G.R.O.s 4652 and 4726.						
	Bread (no millet) ..	652	13·0	45·5	6·50	309	1,510
	Meat (net)	25	4·7	5·0	1·25	—	32
	Vegetables (fresh, mixed)	140	0·7	1·7	—	4	24
	Rice	65½	3·9	5·0	0·26	50	227
	Oil (cotton-seed) ..	29½	—	—	29·50	—	274
	Onions	15½	0·1	0·2	0·50	2	10
	Sugar	14	—	—	—	14	57
	Cheese (native, skim-milk)	26½	5·6	5·8	0·33	—	28
	Dates (or olives) ..	26½	0·2	0·5	0·66	20	91
	Lentils (or beans) ..	109	11·3	29·5	2·18	59	385
	Wheat (Bulgur) ..	113	5·1	16·3	2·26	91	464
	Totals	..	44·6	109·5	43·44	549	3,102
	Non-Turkish Prisoners of War.						
	Non-Labour.						
20.4.17	(1) G.R.O. 2386		49·4	86·4	51·14	336	2,204
10.10.17	(2) G.R.O. 3127		64·4	100·8	47·29	352	2,282
26.1.18	(3) G.R.O. 3462		63·5	95·2	29·77	340	2,062
18.5.18	(4) G.R.O. 3838		54·7	90·3	28·81	351	2,069
18.8.18	(5) G.R.O. 4385		58·3	92·7	33·47	341	2,087
	Canteen Purchases.						
	(*a*) Turkish prisoners of war—*Labour*, April, July, September, 1918	..	0·5	1·1	0·99	9	50
	(*b*) Non-Turkish prisoners of war—*Non-Labour*, November, 1918	..	31·4	51·6	87·2	117	1,501

SUMMARY OF RATION VALUES—*Continued.*

Date		Grm.	Protein Biological value	Protein Gross	Fat	Carbohyd.	Calories
	Egyptian Labour Corps.						
17.4.16	(1) G.R.O. 1117.						
	Bread (25 per cent millet)	906	16·6	61·6	10·8	405	2,023
	Meat (net)	68	12·9	13·6	3·4	—	87
	Lentils	114	12·2	31·5	2·3	63	418
	Rice	57	3·9	4·4	2·3	43	198
	Onions	114	0·6	1·4	0·4	12	58
	Totals	..	46·2	112·5	19·2	523	2,784
	Amount assimilated	..	39·4				
11.9.18	(2) G.R.O. 4449 as G.R.O. 1117, oil being the only extra	..	46·2	112·5	47·7	523	3,048
	Armenian Refugees.						
3.10.15	(1)						
	Bread (maize, 25 per cent)	750	15·0	52·5	7·50	356	1,744
	Meat (net)	8½	1·6	1·7	0·40	—	10
	Rice	15½	0·9	1·1	0·05	12	53
	Beans	9	0·9	2·2	0·20	5	28
	Vegetables	3½	—	—	—	—	—
	Cheese	7	1·0	1·0	1·10	—	14
	Olives	7	—	0·1	1·40	1	17
	Oil	6	—	—	6·00	—	56
	Onions	5	—	—	—	—	2
	Jam	8½	—	0·1	—	5	22
	Sugar	33	—	—	—	33	137
	Totals	..	19·4	58·7	16·65	412	2,081
	Adult male value = ..	..	21·0	60·0	19·83	431	2,200
2.16	(2) Adult male value — ..	—	23·8	66·4	23·30	411	2,174
5.16	(3) ,, ,, ,, — ..	—	26·1	71·7	20·70	420	2,204
9.16	(4) ,, ,, ,, — ..	—	24·3	69·6	31·10	429	2,335
16.10.16	(5) ,, ,, ,,						
	Bread (wheat only) ..	770	16·4	53·9	7·70	365	1,794
	Meat (net)	8	1·5	1·6	0·40	—	11
	Bulgur	19	0·7	2·3	0·30	12	62
	Rice	31	2·0	2·6	0·15	26	116
	Lentils	50	5·4	13·8	1·00	28	180
	Beans	75	7·6	20·0	1·50	40	262
	Vegetables	100	0·5	1·3	—	3	19
	Cheese	12	1·5	1·6	2·00	—	24
	Oil	18½	—	—	18·70	—	174
	Onions	12½	—	0·2	0·04	1	6
	Sugar	20	—	—	—	20	82
	Totals	..	34·6	97·3	31·80	495	2,730
	Adult male value = ..	..	40·9	111·6	39·80	538	3,039
2.17	(6) Adult male value = ..	..	53·9	109·7	56·15	495	3,001
	Interned Turkish Families.						
	Contract, in force November, 1918	..	41·9	95·6	25·26	574	2,988
	Adult male value of above ..	..	55·6	126·0	33·50	761	3,949
	Note.—Pellagra did not occur in these interned families.						
	Scotch Jail Diets (Dunlop).						
	(1) Hard-labour	..	93·8	133·9	91·99	477	3,443
	(2) Light-labour	..	75·3	127·7	71·49	417	2,899

APPENDIX IX.

NOTES ON THE RELATION OF THE BIOLOGICAL VALUE OF PROTEIN TO SOME ESTABLISHED FACTS REGARDING THE EPIDEMIOLOGY OF PELLAGRA.

ACTIVE service affords slight facilities for a detailed study of the voluminous literature of pellagra, and no attempt can be now made to discuss in full the adequacy of the above factor (the "B.P.V.") to meet the fully-established epidemiological facts regarding this disease. But this Report would be incomplete without reference to an eleventh-hour attempt to discover what differences, if any, exist between the Turks' home diets—urban and rural, summer and winter—for which inquiry the aggregation of so many prisoners from so many districts afforded a unique opportunity.

The following table compares the averages calculated from data collected by prisoner M.O.s who, being ignorant of the objects of the inquiry, had no bias for or against any particular view.

THE BIOLOGICAL PROTEIN VALUE OF TURKISH HOME DIETS —AVERAGE OF 110 PRISONERS' ESTIMATES— DAILY AMOUNTS IN GRAMMES.

	Summer.				Winter.			
	Urban		Rural		Urban		Rural	
	Amount	B.P.V.*	Amount	B.P.V.	Amount	B.P.V.	Amount	B.P.V.
Wages	23 pt		15 pt		20 pt		13 pt	
Meat (net) ..	178	34·2	106	20·3	204	38·4	72	13·7
Fowl	47	9·4	60	12·3	86	17·2	26	5·2
Fish	56	12.9	30	6·9	45	10·3	15	3.5
Eggs	81	10·0	112	14·0	53	6·6	53	6·6
Milk	222	7·5	271	9·2	132	4·5	116	3·8
Cheese	126	26·3	150	31·5	127	26·7	135	28·3
Rice	94	5·8	33	2·0	96	5·8	23	1·4
Bulgur	332	11·9	480	17·3	267	9·6	584	21·0
Bread	400	9·6	600	12·0	400	9·6	600	12·0
Totals		127·6		125·5		128·7		95·5
× by ·4		51·0		50·2		51·5		38·2

* "*B.P.V.* = Biological protein value."

Notes on the above Table.

(*a*) The high "B.P.V." figures are in accordance with the before-mentioned "endemicity return" indications that pellagra is very rare in Asia Minor. It is, however, obvious that if any general food scarcity or individual poverty occurred it would affect the rural community most, and also that any incidence of pellagra would present a spring outbreak at the culmination of the long winter privation, when the summer's hoardings became exhausted.

This observation, if confirmed by more extended inquiry, would explain both the distribution of pellagra, by class and occupation, and its seasonal prevalence —the two main features which have hitherto been so difficult of explanation.

(*b*) Careful study of the details of this table shows that it bears inherent evidence of general accuracy. These cannot be now discussed, but attention may be especially drawn to one striking feature—i.e., the remarkable uniformity of the "B.P.V." of the first three diets, selected by choice rather than from necessity, and chosen under circumstances of ample supplies and adequate means. This uniformity in the total "B.P.V." is the more striking when the

variations in the amounts of individual constituents of these three diets are noted. It should be considered in the light of the well-known tendency of practical experience to evolve diets which correspond to physiological needs. Although the "B.P.V.s" of these diets are high, they appear to be uniformly so, and thus comparable. If a general scarcity of food produced a uniform reduction, the lowest row of figures shows that the "B.P.V." for the rural dwellers during the winter would fall below the standard of 40 grammes while the urban residents still maintained a margin of safety.

Epidemiological and other Aspects.

The following remarks are not presented as arguments based upon formed conclusions, but as speculative suggestions indicative of lines of further research which cannot at present be pursued.

(1) The above indication that rural diets have less value than urban diets (which was contrary to expectation when the inquiry was instituted) is explicable by the tendency of agriculturists to send their more expensive animal foods to the better paid town-dwellers, and themselves live principally on cereals. That tendency has been remarked upon particularly in the Egyptian fellahin, among whom pellagra is rife.

(2) In considering the relative conditions of (*a*) agriculturists depending largely for subsistence upon cultivation of cereals on the rich soil of valleys and alluvial deposits, and of (*b*) herdsmen on higher ground forced to rely more upon animal products, it would be anticipated that pellagra incidence would be heavier upon those subsisting upon the products of their fields than upon those depending upon the produce of their flocks.

(3) The position of maize at the bottom of the previously given list of the "B.P.V." of certain representative foodstuffs assumes considerable importance in the light of the association of maize consumption with pellagra. The available literature indicates that pellagra in Europe followed the introduction of maize, and increased in proportion as that cereal was the more generally adopted as a staple article of diet among the poorer classes.

Further the maximum distribution of pellagra appears to correspond geographically to the broad belt where maize grows best and hence forms the larger proportion of food in the classes most pellagrous, thus providing a marked contrast to the tracts where rice—with its high "B.P.V."—is grown and forms the staple diet of equally poor but non-pellagrous communities.

The various organisms and substances isolated from defective maize have not been generally accepted as standing in ætiological relation to pellagra, but decomposition in damaged maize not only indicates a bad harvest, and hence increasing poverty, but also further reduces the "B.P.V." of the damaged maize itself. It is thus probable that the consumption of mouldy maize stands in causative relation to the pellagra observed in conjunction with it, although in a different manner than that hitherto thought.

The "B.P.V." thus affords an equally applicable explanation for the facts (*a*) that maize consumption is associated with pellagra and (*b*) that pellagra occurs among those who have never eaten maize, but who may suffer from deficiency of "B.P.V." through a variety of other dietetic errors.

(4) A similar explanation is offered for the contrasting conditions of the many who suffer from pellagra because of poverty and the few who suffer in spite of affluence. In the latter case the diet may contain ample nutritive material, but idiosyncrasy may lead—as in the Turkish prisoners of war—to an insufficiency of protein being assimilated owing to digestive inefficiency.

Time does not permit of further discussion, but these brief notes suggest that the conclusions formed by this Committee, if confirmed, serve to provide an explanation of the most striking of the established facts regarding the epidemiology of pellagra in relation to:—

Seasonal prevalence.
Geographical and topographical distribution.
Class and occupational incidences.
Previously recognized dietetic associations.

(*Signed*) W. H. Wilson.
P. S. Lelean, *Lieut.Colonel, R.A.M.C.*
H. E. Roaf, *Captain, R.A.M.C. (T.).*

APPENDIX X.

Water Constituents.

Analyses of Nile water in relation to theories that pellagra is due to:—
(1) Excess of colloidal silicon or magnesium.
(2) Deficiency of alkaline salts (Auld and Scala).

As the majority of prisoners of war camps derived their drinking water from the Nile, the following analyses are given.—

Analysis of Nile Water.

Parts per 100,000	High Nile	Low Nile
Solids in suspension	95·28	7·52
,, solution	12·98	25·76
Sodium chloride	0 38	1·87
Alkalinity (as $CaCo_3$)	1·50	4·00
Sulphates (as So_3)	0·31	0·39
Ca (as CaO)	3·58	5·70
Mg (as MgO)	1·06	1·83
Silica	1·05	3·05
Nitrates	Nil	Nil
Ammonia free	0 0016	0·0016
,, albuminoid	0 0040	0·0130
Oxygen absorbed	0·10	0·19

Silicon in Nile water Months	Parts of 100,000 of SiO_2
8.2.17	2·29
8.3.17	2·10
3 4.17	2·00
28.4.17	2·34
2.5.17	2·37
3.7.17	1·61
28.7.17	1·10
6.9.17	1·73
1.10.17	1·60
3.11.17	2·33
5.12.17	1·51

(*Signed*) P. S. Lelean,
Lieut.-Colonel, R.A.M.C.

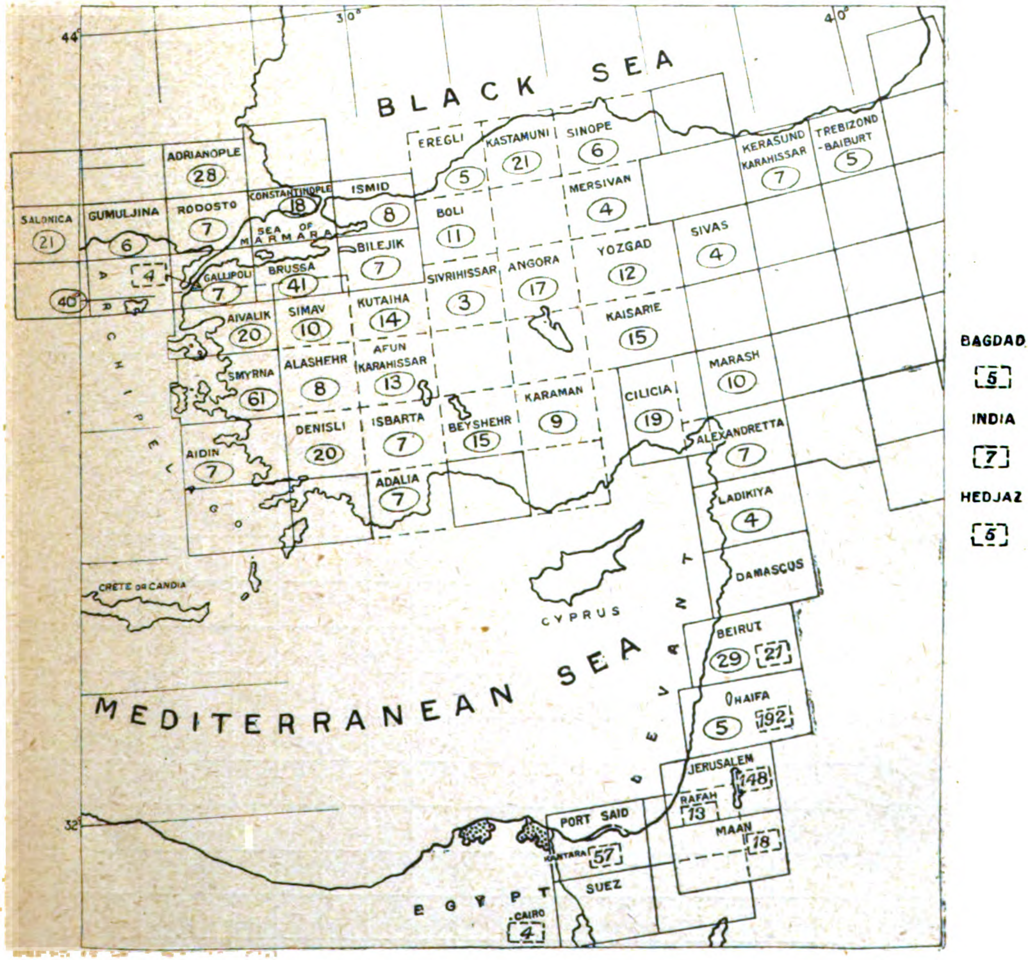
MAP SHOWING

(a) DOMICILE OF 518 PELLAGROUS P. O. WAR

(b) PLACE OF FIRST ONSET OF THE PELLAGROUS SYMPTOMS OF 474 P. O. WAR

ONSET BEFORE CAPTURE 405

AFTER 69



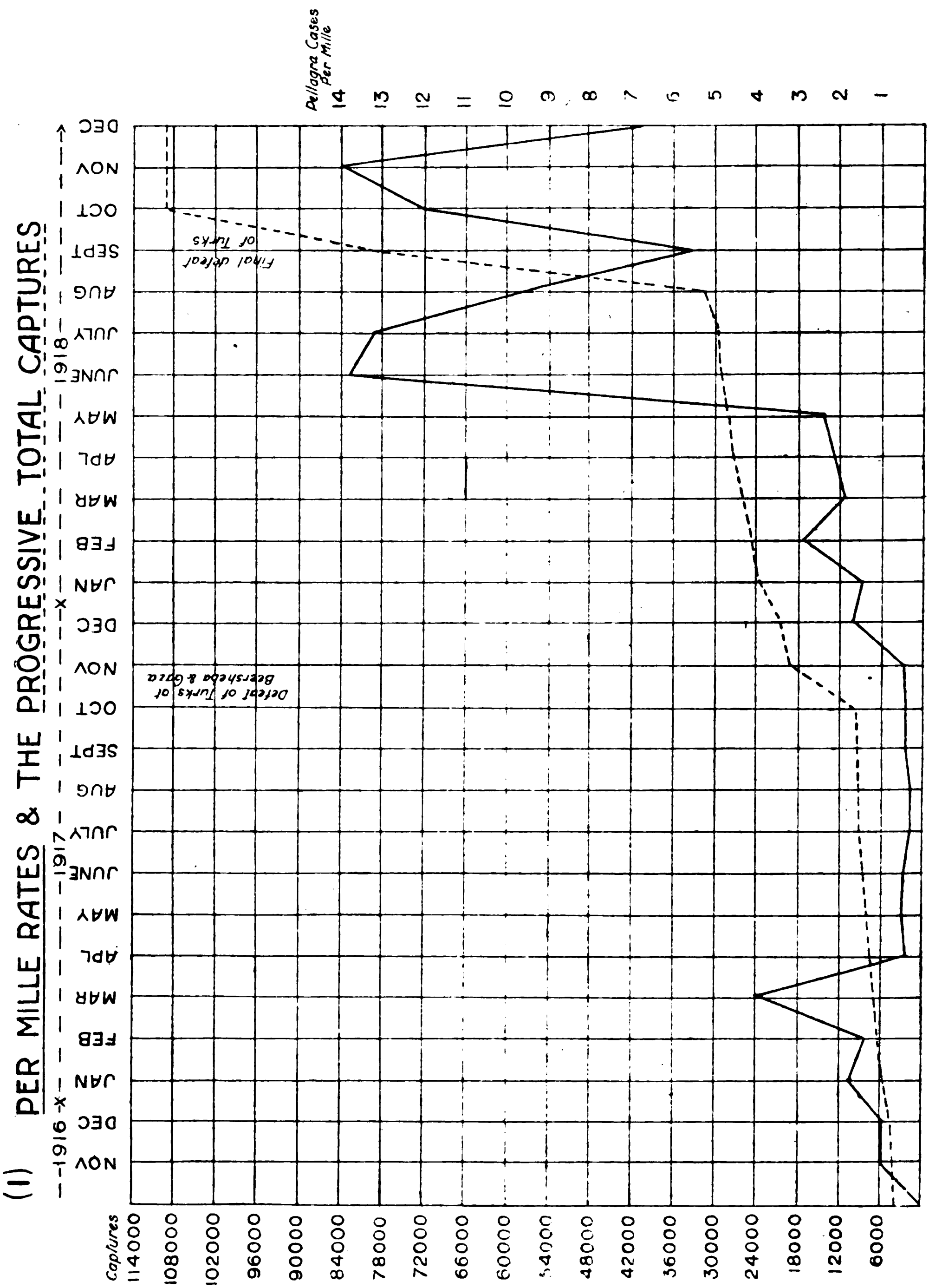

(1) PER MILLE RATES & THE PROGRESSIVE TOTAL CAPTURES
1916
1917
1918
NOV DEC JAN FEB MAR APL MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APL MAY JUNE JULY AUG SEPT OCT NOV DEC
Pellagra Cases Per Mille
14 13 12 11 10 9 8 7 6 5 4 3 2 1
Captures
114000 108000 102000 96000 90000 84000 78000 72000 66000 60000 54000 48000 42000 36000 30000 24000 18000 12000 6000
Defeat of Turks of Beersheba & Gaza
Final defeat of Turks

CHART 1.

(2)

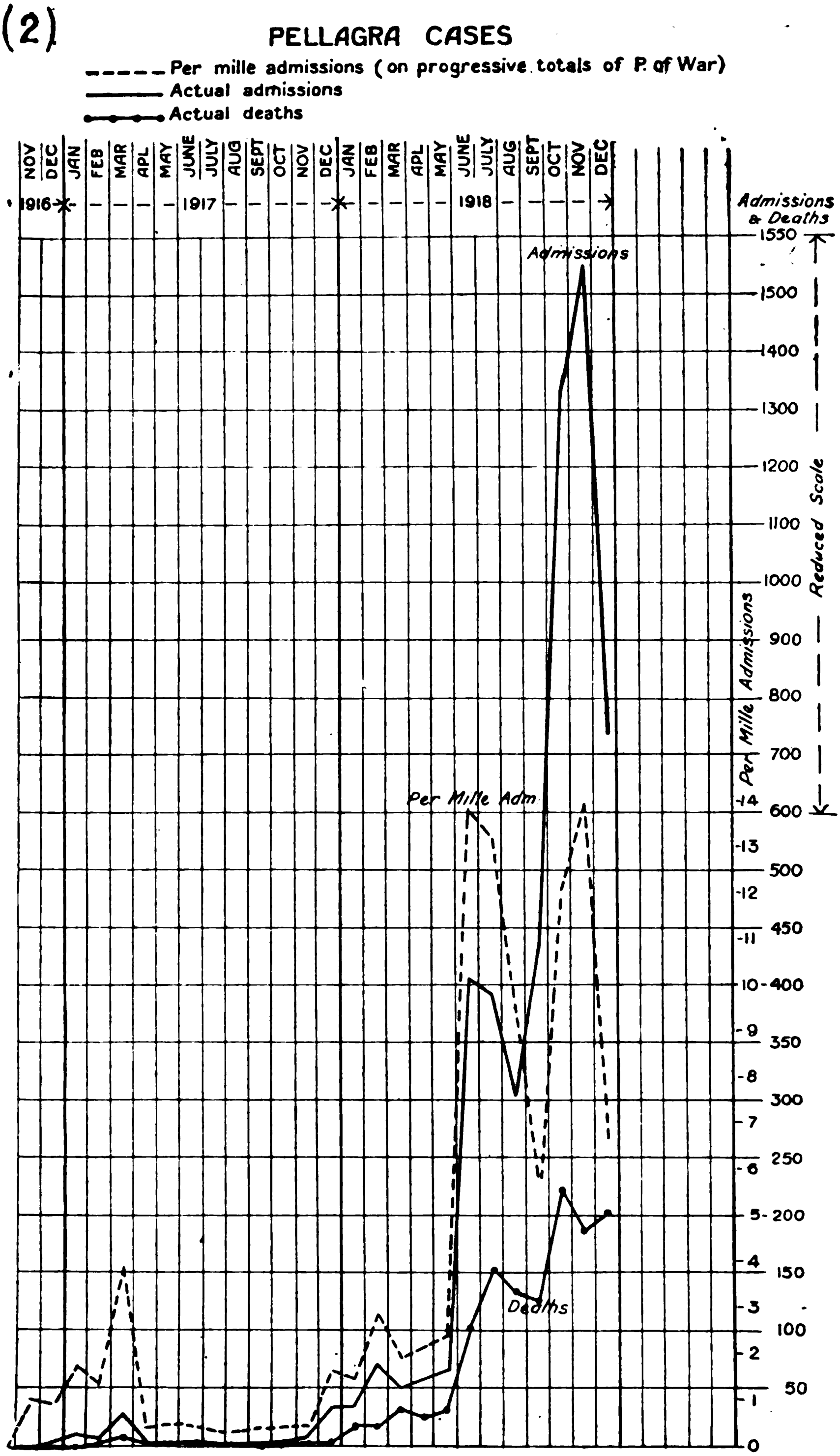
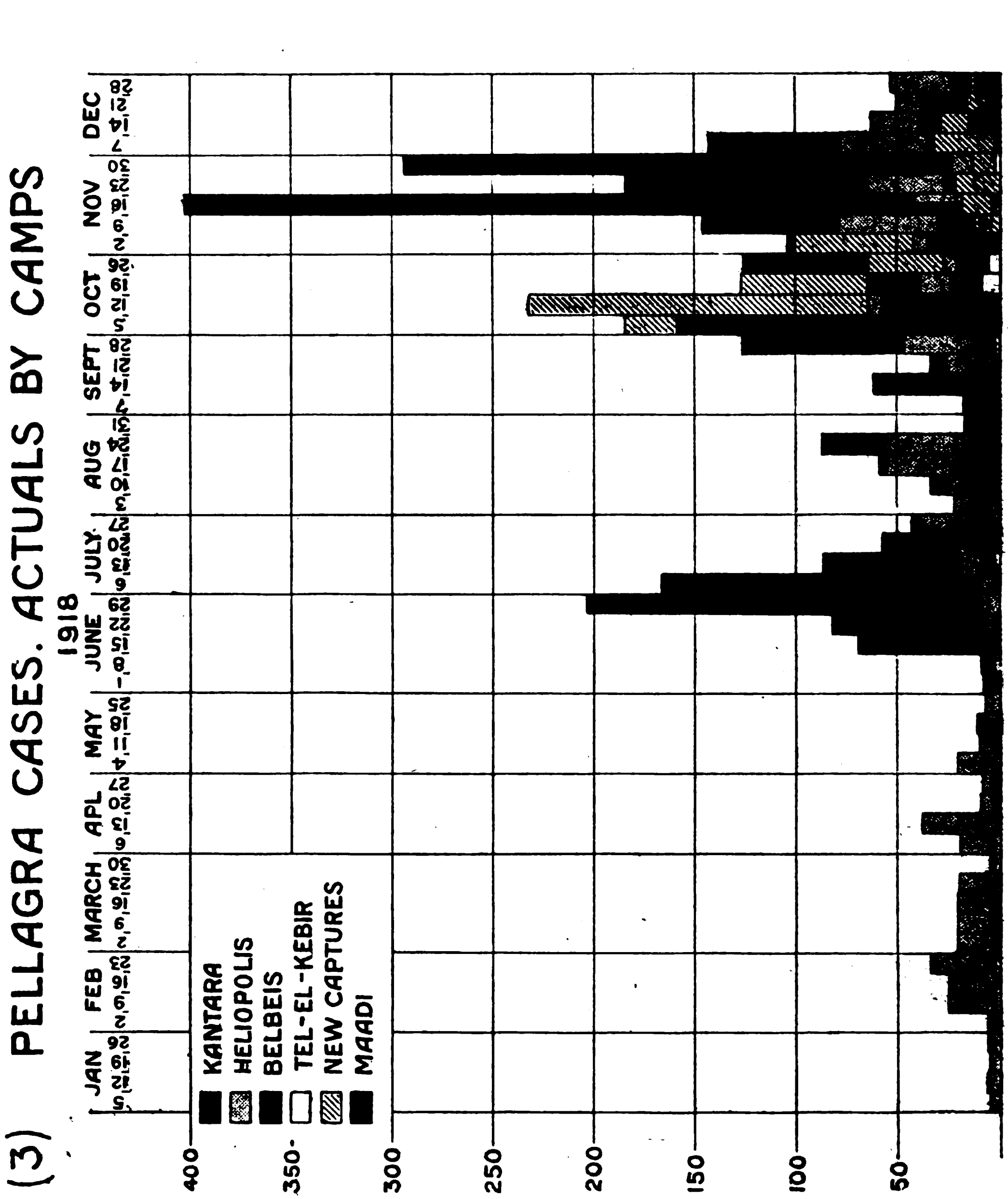

PELLAGRA CASES
Per mille admissions (on progressive totals of P. of War)
Actual admissions
Actual deaths
NOV DEC JAN FEB MAR APL MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APL MAY JUNE JULY AUG SEPT OCT NOV DEC
1916 1917 1918
Admissions & Deaths
1550 1500 1400 1300 1200 1100 1000 900 800 700 600 500 450 400 350 300 250 200 150 100 50 0
Reduced Scale
Per Mille Admissions
14 13 12 11 10 9 8 7 6 5 4 3 2 1
Admissions
Per Mille Adm
Deaths

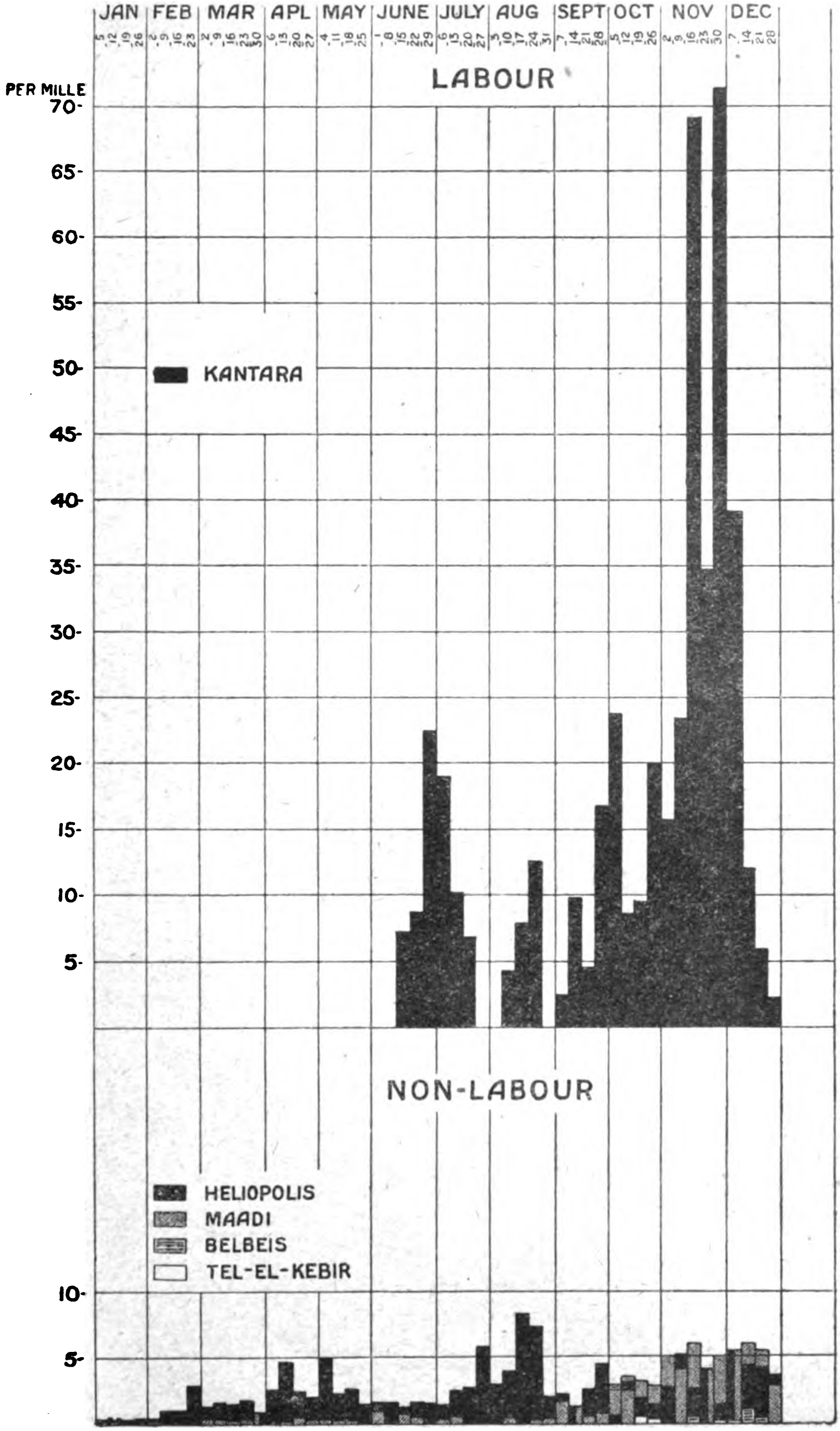
CHART 2.


(3) PELLAGRA CASES. ACTUALS BY CAMPS
1918
JAN
FEB
MARCH
APL
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
KANTARA
HELIOPOLIS
BELBEIS
TEL-EL-KEBIR
NEW CAPTURES
MAADI
400
350
300
250
200
150
100
50

GRAPH 3.

(4) PELLAGRA CASES. PER MILLE RATIOS BY CAMPS

1918



GRAPH 4.

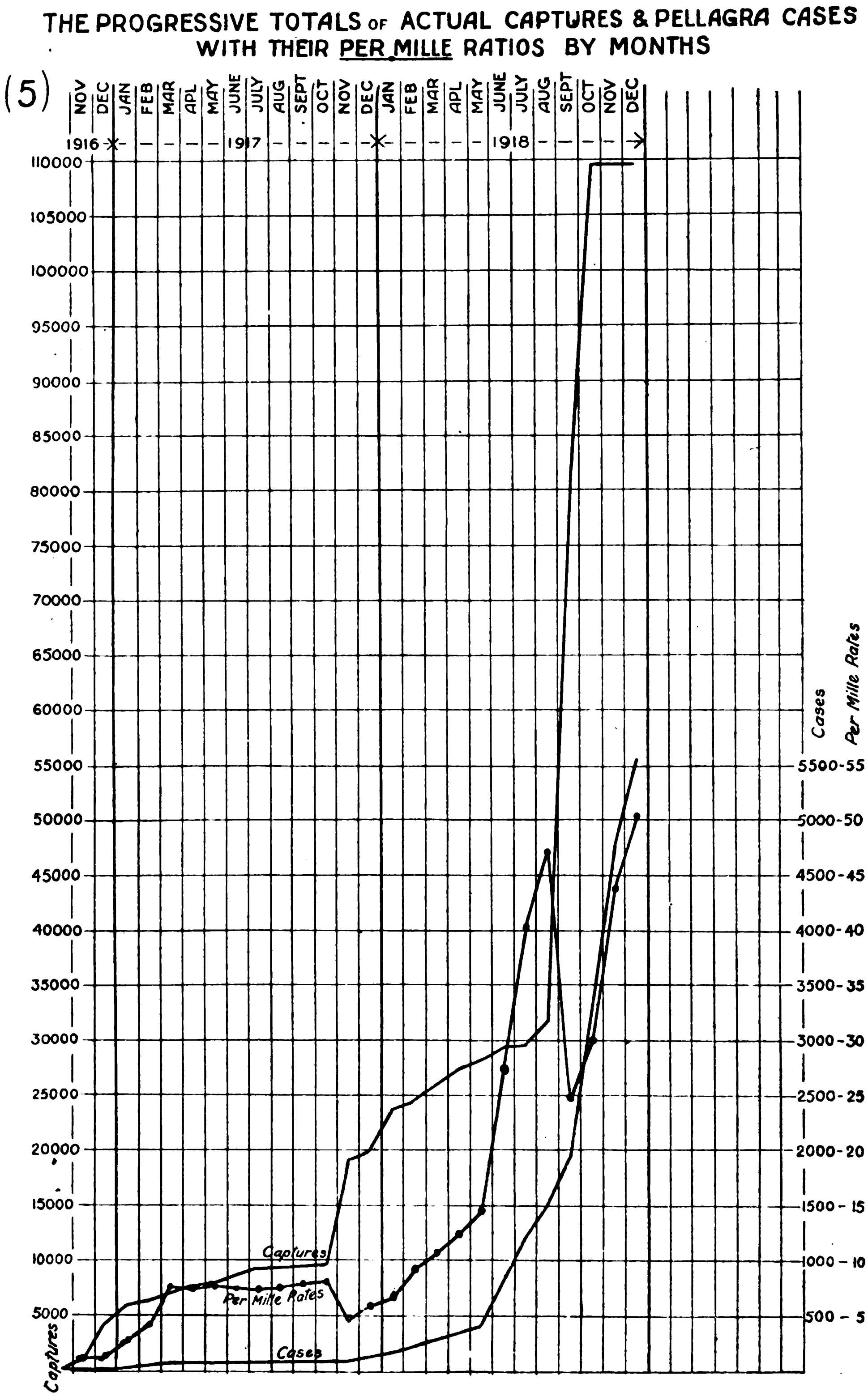

THE PROGRESSIVE TOTALS OF ACTUAL CAPTURES & PELLAGRA CASES
WITH THEIR PER MILLE RATIOS BY MONTHS
(5)
NOV DEC JAN FEB MAR APL MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APL MAY JUNE JULY AUG SEPT OCT NOV DEC
1916 1917 1918
110000
105000
100000
95000
90000
85000
80000
75000
70000
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
Captures
Cases
Per Mille Rates
5500-55
5000-50
4500-45
4000-40
3500-35
3000-30
2500-25
2000-20
1500-15
1000-10
500-5
Captures
Per Mille Rates
Cases

CHART 5.

(6) PELLAGRA ADMISSIONS (PER MILLE) IN RELATION TO CALORIE VALUE OF RATIONS FOR P. OF WAR AT HELIOPOLIS CAMP (NON-LABOUR) AT KANTARA EAST CAMP (LABOUR)

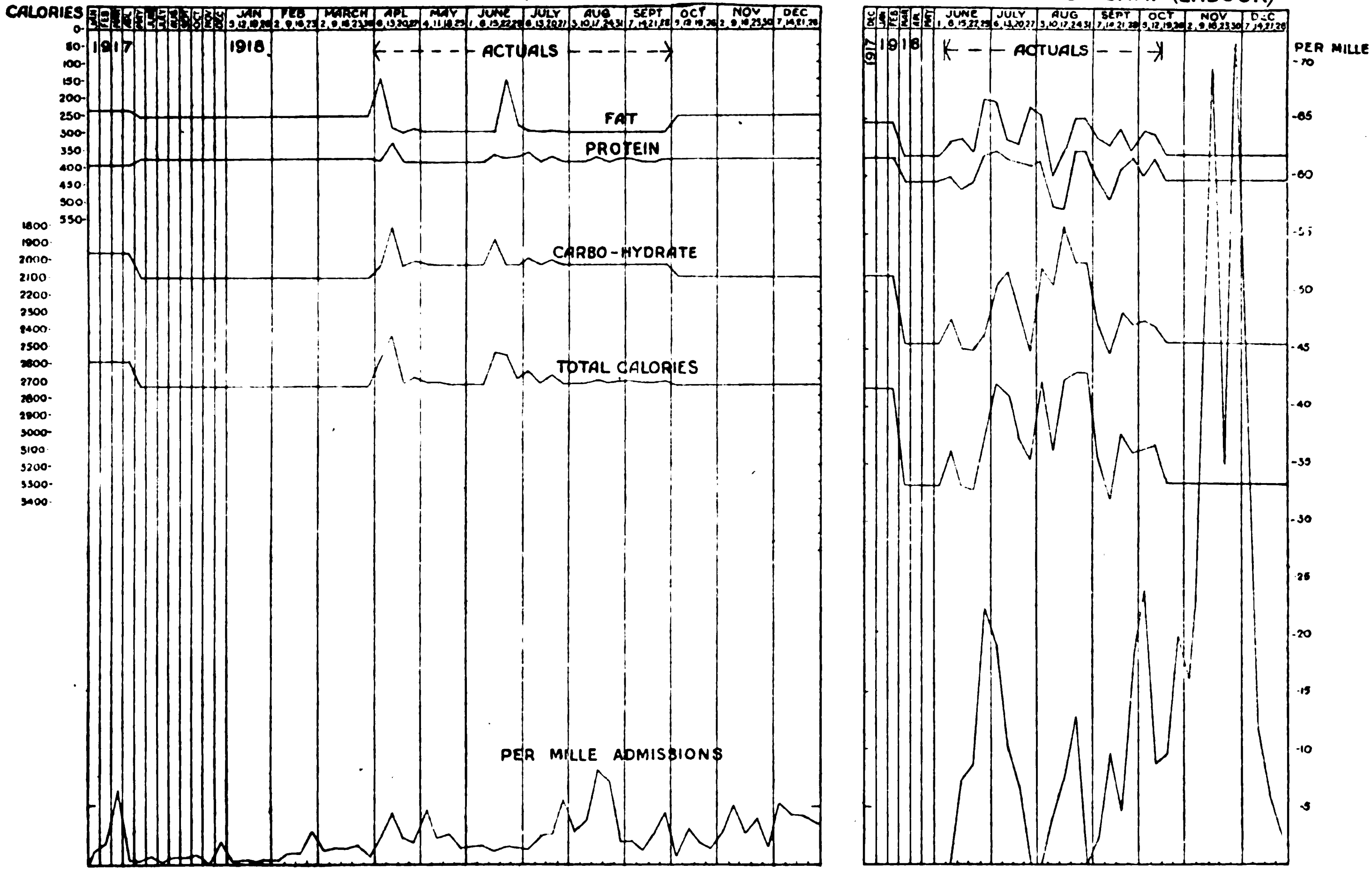
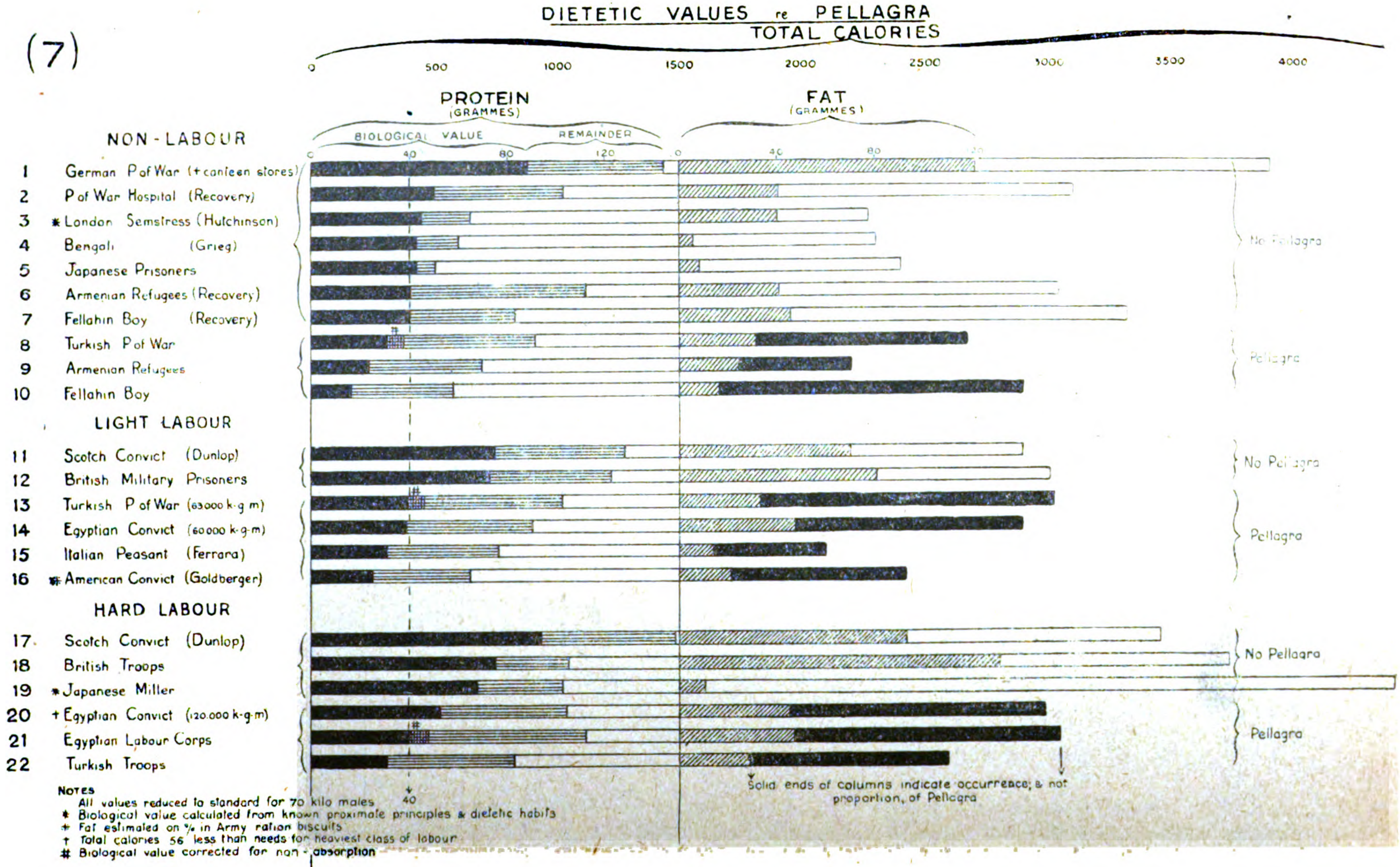


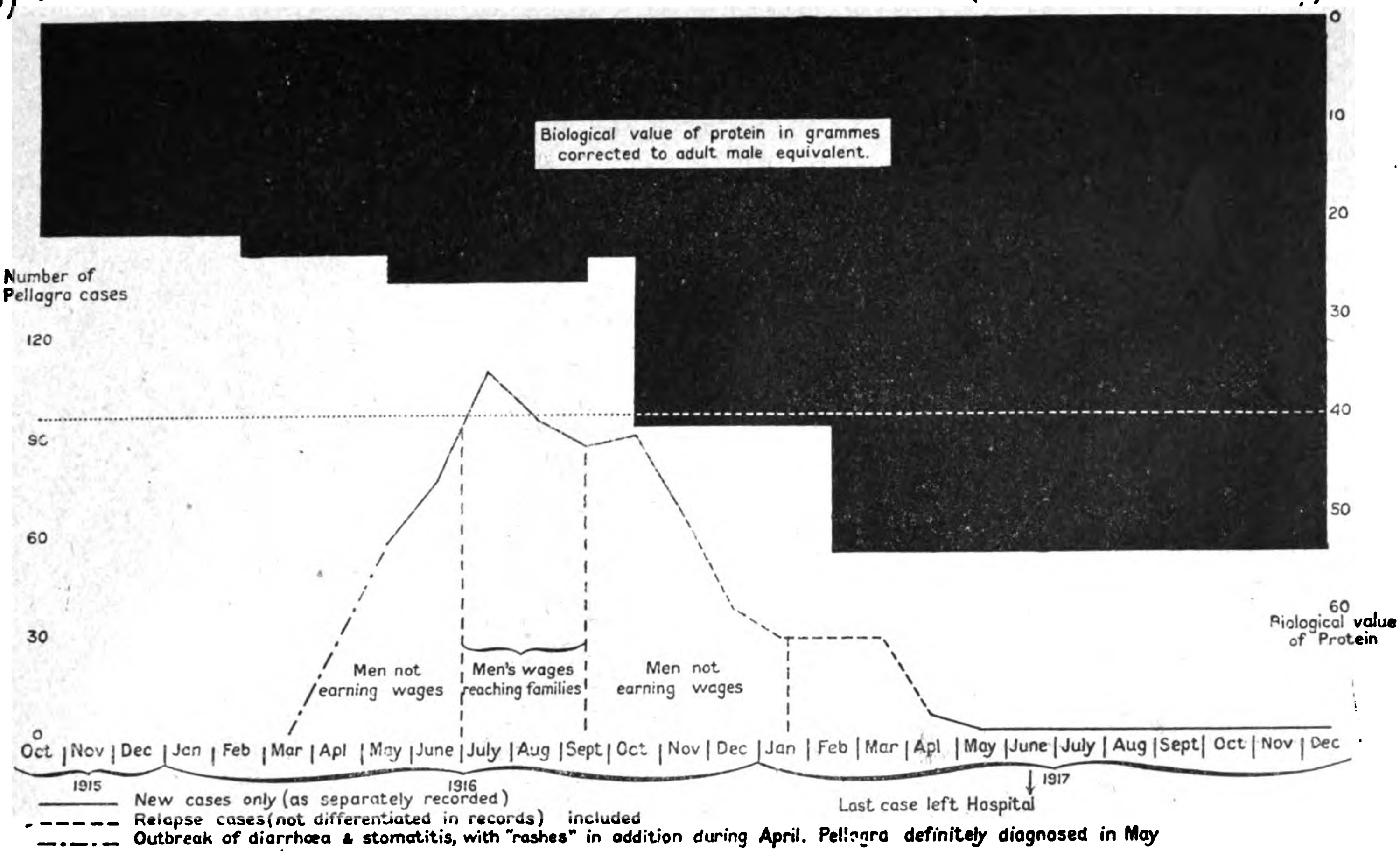
CHART 6.

(7)


DIETETIC VALUES re PELLAGRA
TOTAL CALORIES
0 500 1000 1500 2000 2500 3000 3500 4000
PROTEIN (GRAMMES)
BIOLOGICAL VALUE
REMAINDER
0 40 80 120
FAT (GRAMMES)
0 40 80 120
NON-LABOUR
1 German P of War (+ canteen stores)
2 P of War Hospital (Recovery)
3 * London Semstress (Hutchinson)
4 Bengali (Grieg)
5 Japanese Prisoners
6 Armenian Refugees (Recovery)
7 Fellahin Boy (Recovery)
8 Turkish P of War
9 Armenian Refugees
10 Fellahin Boy
LIGHT LABOUR
11 Scotch Convict (Dunlop)
12 British Military Prisoners
13 Turkish P of War (63000 k.g.m)
14 Egyptian Convict (60000 k.g.m)
15 Italian Peasant (Ferrara)
16 # American Convict (Goldberger)
HARD LABOUR
17 Scotch Convict (Dunlop)
18 British Troops
19 * Japanese Miller
20 + Egyptian Convict (120.000 k.g.m)
21 Egyptian Labour Corps
22 Turkish Troops
No Pellagra
Pellagra
No Pellagra
Pellagra
No Pellagra
Pellagra
40
Solid ends of columns indicate occurrence; & not proportion, of Pellagra
NOTES
All values reduced to standard for 70 kilo males
* Biological value calculated from known proximate principles & dietetic habits
# Fat estimated on % in Army ration biscuits
+ Total calories 56 less than needs for heaviest class of labour
# Biological value corrected for non-absorption

GRAPH 7.

(8) PELLAGRA INCIDENCE AND BIOLOGICAL VALUE OF PROTEIN (ARMENIAN REFUGEES)



GRAPH 8.

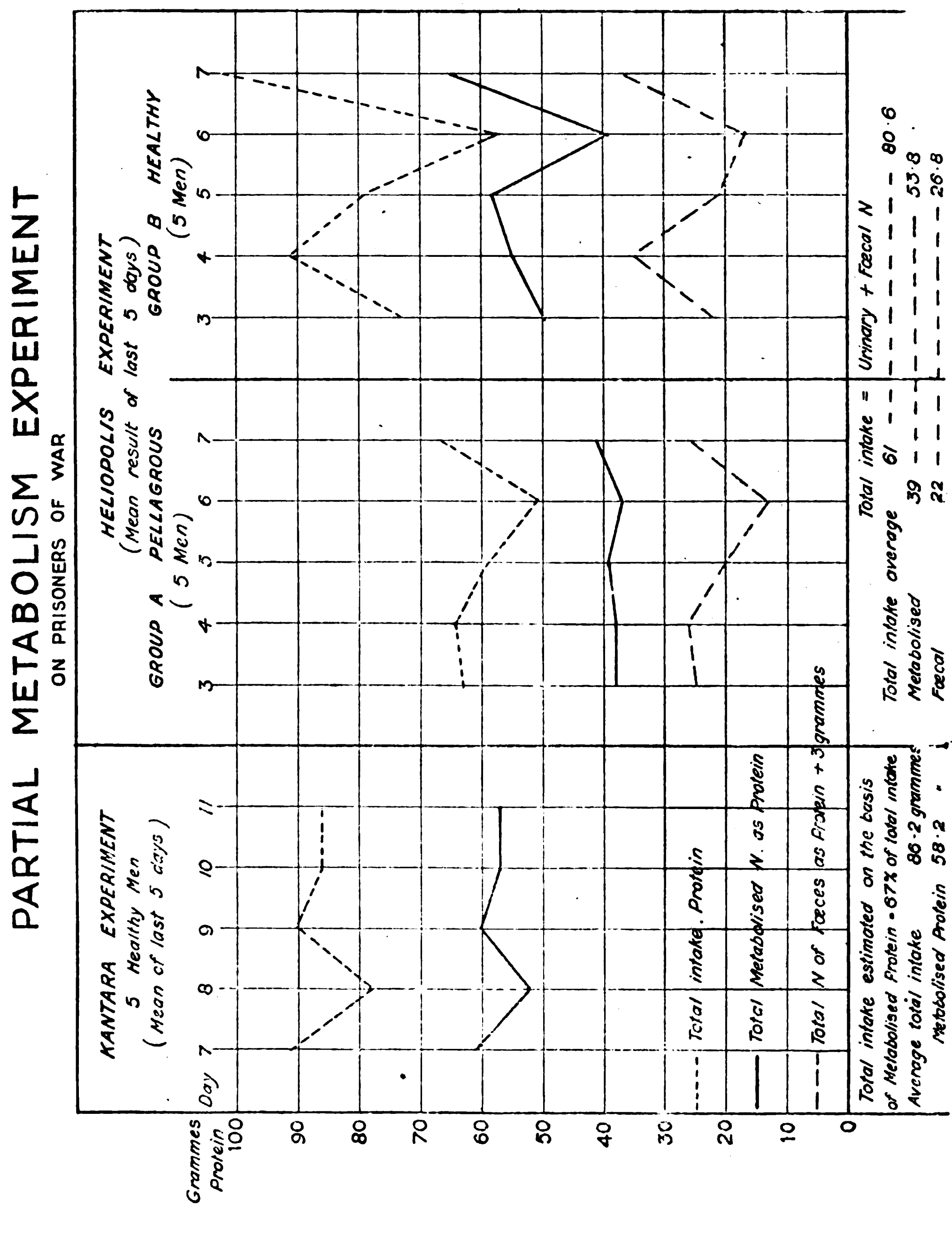

PARTIAL METABOLISM EXPERIMENT
ON PRISONERS OF WAR
KANTARA EXPERIMENT
5 Healthy Men
(Mean of last 5 days)
HELIOPOLIS EXPERIMENT
(Mean result of last 5 days)
GROUP A PELLAGROUS
(5 Men)
GROUP B HEALTHY
(5 Men)
Day
Grammes Protein
Total intake. Protein
Total Metabolised N. as Protein
Total N of Fæces as Protein + 3 grammes
Total intake estimated on the basis of Metabolised Protein = 67% of total intake
Average total intake 86·2 grammes
Metabolised Protein 58·2
Total intake average
Metabolised
Fæcal
Total intake = Urinary + Fæcal N
61 80·6
39 53·8
22 26·8

CHART 9.

Reviews.

AN INTRODUCTION TO GENERAL PHYSIOLOGY WITH PRACTICAL EXERCISES. By Professor W. M. Bayliss, M.A., D.Sc., F.R.S. London: Longmans, Green and Co. 1919. Price 7s. 6d. net.

This introduction to General Physiology by Professor Bayliss affords on the whole an excellent survey of the whole field of physiology. As was to be expected, Professor Bayliss lays much stress on the physical and chemical aspects of the subject. He divides the volume into two parts: the first is text in which he discusses the problems involved; and in the second, he gives a large variety of experiments which serve to illustrate many of the points raised. Although the manner of presentation is clear, the quality is a little uneven and scarcely does justice to the author of the best and most interesting text-book of General Physiology in the English or any other language.

ON FACIAL NEURALGIA AND ITS TREATMENT. By J. Hutchinson, F.R.C.S. London: John Bale, Sons and Danielsson, Ltd. 1919. Pp. xiii + 216. Price 15s. net.

This work which is an amplification of a Jacksonian essay of 1915, treats of facial neuralgias in general and epileptiform neuralgia in particular. The subject is one which the writer has made peculiarly his own, and he speaks with the authority of many years' experience of this class of case, and quotes from a large mass of case material.

He comments in the preface upon the value of alcoholic injections as a substitute for operations, upon the proved ineffectiveness of peripheral operations, and upon the great advances made since Rose first attacked the gasserian ganglion in 1890.

Chapter I deals with special points in the anatomy of the Gasserian ganglion and its branches. The facial paralysis occasionally observed after operation on the ganglion is explained by a possible extension of trouble to the aqueductus Fallopii through the hiatus Fallopii by too wide a separation of the dura. The thin dural investment of the ganglion is noted and the possibility of escape of cerebrospinal fluid during its separation. The intimate connexion of the motor root with the sensory inside the skull, and the impossibility of separating it is insisted upon. Dealing with the main branches and their foramina, it is shown that the mandibular branch has no intracranial course, that the foramina differ much in size and shape and may be asymmetrical, but that their relation to each other and their depth from the surface is constant within certain limits. The cavernous sinus is shown to have a fairly close relation to the deep surface of the ganglion and to the maxillary division and a very close relation to the ophthalmic division. It is pointed out that the position of the foramen spinosum, makes absolutely necessary the ligature of the middle meningeal in order to obtain sufficient space for operating. As regards the distribution of the peripheral branches, the skin of the nose is supplied by the ophthalmic division, as are also the cornea, iris and conjunctiva. The skin over the masseter is supplied by branches from the cervical plexus. These parts remain unaffected in the author's operation. As all the main trunks are accompanied by arteries, alcohol injection is rendered more risky.

Chapter II deals with minor neuralgias which are classified as follows: (1) Neuralgias due to abnormal *blood conditions* such as anæmia, malaria, tabes, etc., or to *hysteria or neurasthenia*; (2) Neuralgias due to *true neuritis*, following

herpes, syphilis, influenza, etc.; (3) Neuralgias due to *local causes*, such as dental caries, eyestrain, iritis, nasal sinusitis, etc.

In all these classes, the pain is continuous, not paroxysmal, and there is a discoverable and removable cause.

(4) *Epileptiform* neuralgia on the other hand has no apparent cause, is not improved by removal of a peripheral lesion and is only cured by excision of the Gasserian ganglion.

The minor neuralgias are then dealt with, especially those due to ocular and nasal causes, syphilis and dental causes. As regards the last, it is admitted that the worst cases may simulate major neuralgia, so that on the one hand, teeth are often uselessly extracted in major cases, and on the other, removal of the ganglion has been performed in minor cases. As regards syphilitic cephalalgia, Dr. Head is quoted as saying that the anterior part of the temporal fossa is a common situation for tenderness and pain which covers a fan-shaped area. But intracranial gumma may also involve the cavernous sinus and its nerves, with ophthalmoplegia and the same fan-shaped area of pain on the face.

True epileptiform neuralgia is described in Chapter III, and the chief features are that it is unilateral, that it begins in the maxillary or mandibular divisions, the ophthalmic being but rarely involved, that the attacks of pain are spasmodic and paroxysmal (the intervals being quite painless) and tend to increase in severity and frequency, that no cause can be found for the onset of the attack, that there is no motor or sensory paralysis as in a true neuritis, that it is accompanied by spasm of the facial muscles, and sometimes by hypersecretion of tears, mucus and saliva, that it most commonly affects adults of both sexes between the ages of 30 and 50, that medical treatment has no effect and that spontaneous cure is unknown. To this terrible picture may be added the fact that sufferers often acquire the morphia habit and not infrequently commit suicide. The author is decidedly against Sir Victor Horsley's opinion that the disease may occasionally have a dental origin, and does not think there is any reliable evidence of its connexion with a family history of epilepsy or insanity. He says emphatically that the disease stands by itself. If a cause of any kind can be found for the attacks of pain, the disease is not epileptiform neuralgia.

Chapter IV continues the discussion of the nature and pathology of true epileptiform neuralgia. The position of neuritis as an ætiological factor is discussed at length and it is shown that true epileptiform cases do not show the continuous pain, and the motor and sensory paralysis characteristic of neuritis. Sir Victor Horsley believed a dental origin possible, but it is urged that the long course of the dental nerves through bony canals is unfavourable to the spread of inflammation and that while in some cases inflammation may spread along nerves, there is no evidence of its doing so in this case. Moreover, though changes in the nerves and vessels have been described, the author has never found any histological changes in excised ganglia or nerves. In cases of pain due to tumour pressure, tissue changes are to be found, but there is also evidence of pressure on surrounding structures, such as the oculomotor nerves and vessels. Epileptiform neuralgia, in short, is a central functional disorder, allied to epilepsy, a spasmodic neurosis, whose sole manifestation is pain.

Chapter V is devoted to the consideration of treatment and begins with a recommendation to make a complete examination of the case, so as to eliminate the possibility of any local causes of neuralgia. There is a word of warning regarding what the author calls the neurasthenic type of facial neuralgia. Operation in these cases is useless. There follows a complete description of treatment by alcohol injections. The usual routes by which the nerve trunks are reached with the needle are given, and some alternative punctures suggested. Attempts have been made to reach the ganglion itself through the foramen ovale, and the author, while insisting on the dangers to important neighbouring parts,

thinks that injecting the ganglion itself gives the best chance of cure by this method, but that injecting the main trunks only ends in return of the pain sooner or later, even when it is successful for a time. As regards operations on peripheral branches, there are a few cases of pain limited to one nerve, which may obtain temporary relief by dealing with that branch only; and accordingly operations are described for reaching the inferior dental by trephining the outer aspect of the ascending ramus of the mandible and for reaching the trunk of the maxillary division intracranially.

Chapter VI, after a brief historical sketch of previous methods, describes the author's modification of the Hartley-Krause operation for removal of the Gasserian ganglion. The main points are the following: (1) the patient is anæsthetized sitting in a dentist's chair, a position which makes the operation area more accessible and diminishes bleeding. The dangers of giving an anæsthetic in this position have been exaggerated; (2) as regards special instruments, an efficient head-lamp and special flexible retractors are required and the author uses small Turkey sponges, cut into inch cubes; (3) the flap of scalp is planned to be entirely within the hairy area; (4) the bone is cut as far down as the infratemporal crest; (5) after exposing and tying the middle meningeal artery, the mandibular and maxillary branches and the ganglion are stripped of dura, the branches cut at the foramina and then the ganglion is divided below the line of the fibres of the ophthalmic division which is left uninjured. Various modifications are then discussed, e.g., whether the operation should be done in two stages, whether the external carotid should be ligatured, the value of division of the main trunks as compared with excision of the ganglion, and of the removal of the entire ganglion with its roots, including the ophthalmic division. It is pointed out also that the pterygoid route of Cushing and Poirier may leave stiffness of the jaw as well as deformity of the face. Some operators advise turning down an osteoplastic flap, but the author gives reasons for his decision that this is unnecessary and even dangerous. He finds also that Abbé's suggestion to divide the maxillary and mandibular divisions and then plug the foramina with rubber dams, is likely to end in recurrence of pain, owing to the strong outgrowth of new fibres from the ganglion. These fibres may actually grow round the rubber dams; and moreover plugging the foramina is difficult, while the saving in time and risk is no greater than in removal of the ganglion.

Chapter VII deals with the results and complications of excision of the ganglion. In the author's operation there is little or no disfigurement, and the cutaneous anæsthesia is limited to the distribution of the maxillary and mandibular trunks. There is also anæsthesia of lips, gums and palate and loss of taste in the anterior two-thirds of the tongue, while the masticatory muscles are paralysed on the affected side. With an intact ophthalmic trunk, however, there is no danger of neuroparalytic keratitis, of oculomotor paralysis, or of laceration of the cavernous sinus. The direct mortality, taking reported figures from many sources, comes to fourteen per cent. Sir Victor Horsley and the author, however, have a mortality percentage of under five per cent. The chief causes of death are shock, hæmorrhage and septic infection. It is acknowledged that sometimes the operation is a failure due to recurrence on the opposite side, or on the same side either in neurotic patients, or where the operation has not succeeded in removing the ganglion. The only proof of successful removal is complete anæsthesia over the area of distribution.

It is impossible in a short summary to do justice to this admirable exposition of a difficult by-path of surgery. The whole work is full of careful and helpful detail and is deserving of close study. A few typographical errors are noticed, e.g., on p. 30, "sore" for "rare"; on p. 149, "p. 17" for "p. 170"; in the last line of p. 42, there should be a full stop after "sclerosis," etc., but generally, arrangement and printing are excellent and the illustrations clear. A copious bibliography is given at the end of the book.

ANÆSTHESIA AND THE NURSE'S DUTIES. By A. de Prenderville. With an Introduction by Sir James Cantlie, K.B.E. Published by William Heinemann. London, 1919. Pp. x and 100. Price 3s. 6d.

The author of this little book died before its publication and Sir James Cantlie in the introduction pays an eloquent tribute to his gifts as an anæsthetist.

As pointed out in the preface the book is based on a series of lectures delivered to the nursing staff of Charing Cross Hospital, and the author is clearly in favour of selected nurses being trained as anæsthetists.

The book is pleasantly written and should appeal to a wider public than the nurses for whom it is intended. There is much in it that is of value to every practitioner.

The historical sketch of the discovery and introduction of anæsthetics is worthy of very special mention.

The preparation of the patient for operation and his care after return to the ward, for which the trained nnrse is responsible, are most clearly and thoroughly described.

Many complications have been described that may arise during the course of the anæsthesia, the prevention and treatment of which strictly belong to the anæsthetist, but a knowledge of these are certainly valuable to the nurse and will help her to render intelligent assistance in the operating room in case of emergency.

The book is excellently printed and clearly illustrated and is certain to be widely read. J. W. W.

PYE'S ELEMENTARY BANDAGING AND SURGICAL DRESSING. Revised by V. Zachary Cope. Fourteenth edition, 1919. Published by John Wright and Sons, Ltd., Bristol. Simpkin, Marshall, Hamilton, Kent and Co., Ltd., London. Pp. viii and 232. Price 3s. 6d. net.

The fact that this little book has reached its fourteenth edition is sufficient evidence that it fills an important place in the training of the medical student and the voluntary aid societies.

It contains all that is necessary for the dresser commencing work in a hospital and is full of valuable hints for those more advanced in their studies.

It has been brought up to date from H. W. Clayton-Green's eighth edition of Pye's Surgical Handicraft. J. W. W.

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Journal

of the

Royal Army Medical Corps.

Original Communications.

A NOTE ON THE RATE OF MARCHING AND THE EXPENDITURE OF ENERGY IN MAN.

By LIEUTENANT-COLONEL E. P. CATHCART, F.R.S.
Royal Army Medical Corps.

BREVET MAJOR N. V. LOTHIAN, M.C.
Royal Army Medical Corps.

AND

CAPTAIN M. GREENWOOD.
Royal Army Medical Corps (T.).

THE whole question of the influence of the rate at which the work of forward progression is carried out and whether there exists an optimum rate is one of very considerable importance both from the purely economic and the strictly military point of view. In this latter instance, where the two interests tend to clash, a definite solution of the problem would be of great value. The question might become of prime importance particularly in open warfare, where the men must advance as the exigencies of the position demand, but at the same time this advance can only be made at the cost of a considerable output of energy, energy which must be made good by the supply branches. Can it be definitely stated that there is an optimum rate of progress, or is the movement of unit mass through unit distance done at constant cost so that the energy output bears a constant ratio to the distance actually covered in unit time—i.e., is it relatively as costly to march at three miles per hour as it is when the pace is increased to five miles per hour?

The question is one which has engaged the attention of a large number of workers but, so far as we are aware, only once, in addition to the recent discussion of the problem by Cathcart and Orr [1], has it been dealt with from a military point of view, viz., by Zuntz and Schumburg [2].

Although the results of Zuntz and Schumburg are of considerable interest and value it is probable that their final generalization that the cost of moving unit mass through unit distance increases with the velocity is not strictly true. Others who have worked at the problem are Amar [3], Durig [4], Brezina and Kolmer [5], Brezina and Reichel [6], and more recently Benedict and Murschhauser [7]. Of these workers the two who have gone into the matter in most detail from the statistical point of view are Brezina and Kolmer and Brezina and Reichel. These authors dealt with the problem in the following way. Observations, by the method of indirect calorimetry were made upon a subject marching over a level track under different loads and at different rates. The total expenditure in calories per minute was thus determined and to obtain the net cost of the work done a constant deduction was made to cover the basal or standard metabolism. The remainder divided by the distance in metres covered per unit of time and by the mass (body weight plus load) moved, reckoned in kilogrammes, was taken to be the cost per kilogrammetre of movement. The resulting series of figures were analysed and the conclusion drawn that the cost of movement (in the above defined sense) remained constant up to a velocity of the order of eighty metres per minute and thereafter increased geometrically. Brezina and Reichel publish graphs exhibiting a fair concordance between the postulated theory and the observed facts and are in general agreement with the views of Durig on the subject.

The relation defined by Brezina and Reichel may be regarded from two points of view: (*a*) as a general physiological law, or (*b*) as an interpolation formula useful for deducing values within the range of the observations.

From the former point of view it is a considerable objection that the law involves a discontinuity, the relation between speed and energy expenditure changing suddenly at a fixed point. There is the further objection that other experiments upon the cost of movement have suggested that below a certain optimum, work is not economically performed (Frentzel and Reach [8]).

From the latter standpoint it is to be noticed that Brezina and Reichel's experiments are not suitable for the determination of the goodness of fit of a formula because, although the range of speeds observed is adequate, only a single experimental measurement was available at each speed; what is needed is a considerable number of observations at each speed so that the variability of the arrays may be determined and goodness of fit criteria applied.

The justice of the second criticism can be rendered plain by applying a simple test. If for example the observations are graduated upon a wholly different hypothesis and the resulting graduation compared with that based upon Brezina and Reichel's theory and it is found that the two graduations are about equally good it follows that neither hypothesis need be correct but that both are equally suitable as interpolation formulæ.

With this object in view twenty-one measurements made under a load of twenty-four kilos given in the table on p. 172 of Brezina and Reichel's paper were selected. These form the second column of Table I.

TABLE I.—BREZINA AND REICHEL'S OBSERVATIONS ON A 67 KILO. MAN MARCHING UNDER A LOAD OF 24 KILOS., AT VARYING SPEED.

Metres per min.	Observed cals. per kilo. per min.	Calculated 1	Calculated 2	Percentage error 1	Percentage error 2
43·5	0·49	0·51	0·61	4·1	24·5
47·0	0·50	0·51	0·55	2·0	10·0
48·1	0·57	0·51	0·54	10·5	5·3
50 5	0·51	0·51	0·51	0	0
59·8	0·54	0·51	0·46	5·6	14·8
61·3	0·52	0·51	0·46	1·9	11·5
65·6	0·46	0·51	0·46	10·9	0
65·9	0·50	0·51	0·46	2·0	8·0
66·4	0·45	0·51	0·46	13·3	2·2
71·2	0·52	0·51	0·48	1·9	7·7
72·9	0·50	0·51	0·48	2·0	4·0
76·2	0·51	0·48	0·50	5·9	2·0
77·7	0·51	0·50	0·51	2·0	0
84·6	0·58	0·55	0·56	5·2	3·4
92·0	0·59	0·62	0·62	5·1	5·1
92·3	0·57	0·62	0·63	8·8	10·5
94·9	0·58	0·64	0·65	10·3	12·1
104 7	0·80	0·75	0·76	6·3	5·0
105·1	0·72	0·75	0·76	4·2	5·6
115·8	0·91	0·88	0·89	3·3	2·2
115·8	0·91	0·88	0·89	3·3	2·2
				Means 5·2	6·5
				Means, omitting first observation 5·2	5·6

As Brezina and Reichel do not publish their graduated figures an attempt was made to calculate some by what we take to be their method. Thus, it was assumed that the metabolic cost was constant and equal to the average cost for speeds up to 72·9 metres per minute and that thereafter the increase was geometrical, so that, for the latter range, we deduced graduated values by assuming a linear relation between the logarithms of the cost and the actual speeds and obtaining the constants by the method of least squares. The third column Table I gives the expected value thus obtained. A different hypothesis was then adopted. It was assumed that the relation between energy cost per unit of time and speed was represented by a parabola, $y = ax^2 + bx + c$; where y is the cost per unit of time and x the distance covered in unit time, so that cost per kilo per metre would be given by a hyperbola of which the axis of y is an asymptote—implying that the cost of work is at first great and diminishes to an optimum value, thereafter again increasing. The parabola was fitted by least squares and the graduated values subsequently derived as indicated; they are given in the fourth column of Table I. It will be seen that the first graduated value by this method diverges much more from observation than that of

Brezina and Reichel's process; with that exception there is nothing to choose between the two graduations. Judged by the very rough test indicated in the table and remembering that the error of individual determinations (vide infra) is of the order of five per cent, one cannot say that either graduation deserves preference.

This result is of some importance because the data obtained from our series of experiments, while superior to those of Brezina and Reichel inasmuch as several determinations have been made at each observed speed are inferior in that three rates of speed only were available, viz., 60, 90 and 120 yards per minute. It follows that the mean points can always be made to lie upon a second order parabola there being just three equations to determine the three independent constants. Hence the fact that a parabola represents the observations perfectly does not at all guarantee its theoretical basis (weighting the points with the number of observations and fitting by least squares will make no difference since the parabola through the points will evidently fulfil least square conditions). It may also be remarked that the theoretical objections to supposing that the physiological law can be expressed by a parabola are nearly as strong as against the hypothesis of a preliminary range of constant costs. As noticed above a parabolic relation for the output in unit time with varying pace leads to the inference that the cost of work in Brezina and Reichel's sense is indefinitely great for indefinitely slow rates of performance; although we consider that it should be greater than at some finite rate it cannot of course be indefinitely large. Hence we go no further than to suggest that a parabola is a convenient interpolation formula. To ascertain the real law we must have many sets of observations over a wide range; these are not yet available.

In the course of an experimental inquiry in connexion with a series of tests on various types of equipment, a number of observations (152) were made on the cost of marching at three different rates, viz., 60, 90, and 120 yards per minute, with definite load, and a further series of 23 observations relate to two other tests under other loads, but do not give records for each at the three standard rates of marching. The experiments were all carried out under identical conditions, viz., in a well-lit laboratory, thirty yards in length. The temperature throughout was practically uniform. The subjects employed were Mo. height, 174·6 centimetres; weight, 63·2 kilogrammes; Nf. height, 160·0 centimetres; weight, 60·0 kilogrammes; Pl. height, 176·5 centimetres; weight, 68·2 kilogrammes, and Oc. height, 184·2 centimetres; weight, 66·4 kilogrammes.

In the first place, in order to determine the range of variation of individual experiments, a subject which has not, so far as we are aware, been previously discussed on the basis of a long series of experiments under uniform conditions, a series of 96 observations on subject Pl., which relate to the metabolism when marching at the rate of 90 yards per minute, with a total weight of 95 kilogrammes (68·2 kilogrammes live

weight, plus 26·8 kilogrammes load) were examined. If 0·20 calorie be taken as the unit of grouping, the resultant data are shown in Table II.

TABLE II.—OBSERVATIONS ON PL. MARCHING AT NINETY YARDS PER MINUTE. LIVE WEIGHT 68·2 KILOGRAMMES. LOAD 26·8 KILOGRAMMES.

Calories per min.	Observation	Graduated by a normal curve Mean = 5·2615 cals. Standard deviation = 0·3217 cals.
—4·70	3	4
4·70—4·90	12	9
4·90—5·10	13	17
5·10—5·30	26·5	23
5·30—5·50	19·8	21
5·50—5·70	14	14
5·70—5·90	5	6
5·90—6·10	2	2
6·10—6·30	1	

If this be taken as a frequency distribution, it is found that the mean is 5·26 calories, and the standard deviation 0·32 calorie. Fitting a normal curve of error, figures are obtained (Table II) which agree well with the observations. The goodness of fit is measured by $P = 0·83$; in other words, were the distribution truly normal, we should, in sampling, get no better agreement than that found in more than eight out of ten trials. There need accordingly be little hesitation in assuming that the distribution of "error," or variations, is adequately described by the normal curve. From a table of the normal curve we find that, for our experiments, the odds are nearly 9 to 1 that a single observation taken at random will not differ from the mean of all by $\pm$ 10 per cent, and over 900 to 1 that the divergence will not amount to 20 per cent. If three times the probable error, the conventional limiting value, be taken to mark differentiation, that limit is just over twelve per cent. The variation or "error" here involved is compound—in part dependent upon the errors of experimental technique; in part to be referred to physiological variations of the subject, either intrinsic or due to environmental changes. To isolate the factors, it would be necessary to examine a series of analyses relating to the same gas sample. A short series of such measurements have recently been carried out by Greenwood, Hodson, and Tebb [9], and their work renders it probable that, even with only moderately experienced analysts, more than half the "error" above calculated is not technical, but physiological,

The relation of speed to cost must now be considered. Table III contains the equations determined from the mean heat productions at each speed for each set of observations, and also reduced to terms of 100 kilogrammes. It may be noted that this reduction, while facilitating comparison, is subject to serious criticism, for it assumes that cost of work at constant speed is independent of the total absolute mass moved, and, further, that no distinction need be made between live weight and dead weight in the calculation. The second assumption cannot be correct, since we are dealing with gross cost, i.e., not excluding the basal metabolism,

while the first is unsupported by evidence. We have not, however, sufficient material to provide a more exact method of reduction to a common standard.

TABLE III.—EXPERIMENTS AT THREE RATES OF MARCHING; 60, 90 AND 120 YARDS PER MINUTE.

Subject	Mass moved in kilos.	Number of observations	Equations (Y = Cals. and x = yds. per min.) — Actual equation	Equations (Y = Cals. and x = yds. per min.) — Reduced to terms of 100 kilos.
Pl.	95·0	114	$Y = 5·914 - ·08530\,x + ·000866\,x^2$	$Y = 6·225 - ·08979\,x + ·000912\,x^2$
Mo.	88·6	12	$Y = 5·605 - ·08112\,x + ·000846\,x^2$	$Y = 6·326 - ·09156\,x + ·000955\,x^2$
Oc.	92·4	9	$Y = 3·967 - ·04327\,x + ·000659\,x^2$	$Y = 4·293 - ·04683\,x + ·000713\,x^2$
Mo.	71·6	6	$Y = 4·755 - ·06749\,x + ·000683\,x^2$	$Y = 6·641 - ·09426\,x + ·000954\,x^2$
Oc.	75·4	6	$Y = 1·780 + ·00800\,x + ·000272\,x^2$	$Y = 2·361 + ·01061\,x + ·000361\,x^2$
Nf.	69·0	5	$Y = 3·020 - ·03516\,x + ·000483\,x^2$	$Y = 4·377 - ·05096\,x + ·000700\,x^2$
From all observations, 175 (including twenty-three observations on two other subjects).				$Y = 6·700 - ·09967\,x + 000967\,x^2$

The last equation in the table (Table III) was obtained by working out the mean heat production per 100 kilogrammes at each speed from all the observations, and then calculating the constants.

It will be seen that the equations summarising the experiments upon Pl. and Mo. under different loads have very similar values for the constants; whether the divergencies seen in the others, neither of them very satisfactory subjects, are fundamental or due to random error, we have no means of knowing. All the equations lead, notwithstanding the differences of the constants, to essentially the same optimum rate of marching.

TABLE IV.—APPROXIMATE EXPENDITURE DURING ONE HOUR BY A MAN MARCHING ONE MILE AT VARIOUS SPEEDS WITH A TOTAL WEIGHT OF 95 KILOGRAMMES.

Yards per min.	Cost per min.—Cals.	Cost per mile—Cals.	Time taken for 1 mile—mins.	Cost per hour—Cals. I	Cost per hour—Cals. II
50	3·815	134·3	35·2	166·5	169·0
55	3·845	123·0	32·0	159·4	161·9
60	3·918	114·9	29·3	154·8	156·4
65	4·034	109·3	27·1	152·1	154·8
70	4·193	105·4	25·1	150·8	153·7
75	4·396	103·1	23·5	150·6	153·7
80	4·642	102·1	22·0	151·5	154·8
85	4·932	102·1	20·7	153·2	156·8
90	5·265	103·0	19·6	155·5	159·5
95	5·641	104·5	18·5	158·5	162·8
100	6·060	106·7	17·6	161·8	169·0
105	6·523	109·3	16·8	165·5	173·3
110	7·029	112·5	16·0	169·7	178·2
115	7·578	116·0	15·3	174·1	183·5
120	8·170	119·1	14·7	178·0	191·8
125	8·826	124·3	14·1	184·0	199·0
130	9·485	128 5	13·5	184·0	205·4

The equation giving the cost per kilo moved per yard is obtained by dividing the above expressions by x so that, if the new variable y/x be written Y, the equation becomes $Y = \frac{ax^2 + bx + c}{x}$ a hyperbola. Differentiating we find that the value x which makes Y a minimum is given by putting x equal to $\sqrt{\frac{c}{a}}$.

The fourth column of Table IV gives the cost per mile deduced from the equation $Y = \frac{5{\cdot}9 - 0{\cdot}085x + 0{\cdot}000866x^2}{x}$, i.e., that deduced from the observations on Pl. under a load of 26·8 kilos.

An interesting question here suggests itself. Suppose the problem to be to transport the mass of 95 kilogrammes over, say one mile, with the least hourly expenditure of energy, that is, a distance of one mile is to be marched and there is an hour available to do it in, is it more economical to march the mile rapidly or slowly, and have a longer or shorter period of rest? We now desire to calculate the total hourly expenditure, i.e., the expenditure during the time occupied in marching, and that in resting. To take a specific example, the total hourly expenditure involved in marching 1 mile, at a rate of 50 yards per minute, would be 134·3 calories for the 35·2 minutes occupied in the march, and for the remaining 24·8 minutes at rest, at a cost of 1·3 calories per minute, 32·2 calories; in all, 166·5 calories for the hour. The resting value, as in the case of the other data in the table, was the average value of a large number of observations on subject Pl. If, then, we add to the cost per mile the product of the time of resting into the postulated rate per minute, the results detailed in column 5, Table IV, are reached. But this ignores the stimulation of basal metabolism due to the foregoing exercise. Hence, in order to solve the problem proposed, we should ascertain whether stimulation of basal metabolism is or is not a function of the rate of previous work performance. A certain amount of work has been done to solve this problem, although, so far as we are aware, no investigation has been definitely undertaken to correlate increased post work metabolism with the cost of the previous work. Loewy [10] briefly touches on the question, drawing attention to the fact that after cessation of work there is a rapid fall in the intake of oxygen. After moderate work the consumption returns to normal in the course of some six minutes, and after hard work in ten minutes. He concludes that, on the average, the increase in oxygen consumption during the whole after-period amounts to about the consumption during one minute of the working period, provided the work is done comfortably and without undue fatigue. He admits that after severe work the oxygen intake during the post work period may equal the oxygen intake during two or three minutes of the work. Benedict and Cathcart [11], who also investigated the problem, found that there was a very definite stimulation of metabolism as the result of previous work. Although the general statement (E. Smith [12] and many subsequent workers) is that the effect

is very transitory, five minutes, at most, after ordinary work, Benedict and Cathcart found that the increase might be continued for several hours. If Table CXXXVI, p. 166, *et seq.*, of their monograph be consulted, it will be noted that there is a very persistent increase in metabolism following severe muscular activity—a change, it is interesting to note, which is barely indicated by the mere examination of the carbon dioxide output during the period. With the least severe forms of work, it was found that "the after effect of muscular work is but little greater than that given by Loewy, namely, that the total excess oxygen consumption following work is approximately the same as for one minute of hard work." This general deduction was not found to hold, however, when the work done was severe or prolonged. The increase noted was unquestionably due to the previous muscle work, and, in one of the experiments, at least, it was shown to persist for over five hours.

Accordingly, in column 6 of Table IV, an attempt has been made to assess the value of the hourly output more accurately than was done in column 5. For the marching rates of 50 to 95 yards per minute, i.e., with an output under 6 calories per minute, the cost of one working minute was added, the balance of the time of resting being assessed at the resting value of 1·3 calories. For rates between 100 and 115 yards per minute, i.e., with a minute calorie value below 8, the cost of one working minute and a half was added, and for values of 8 and above, the cost of two working minutes was added. It is admitted that the figures obtained are but a rough approximation; still, they show that apparently there is an optimum rate at which work can be carried out. It is, however, always possible that the seeming economy of a particular rate of expenditure may not be more than an appearance.

As we have remarked more than once, the calculations founded upon these experiments do not pretend to afford more than an interpolation formula valid within quite narrow ranges of speed. A principal object of this note is to call attention to the fact that in this branch of physiology zeal often outruns discretion. With the help of a little algebra and some drawing paper, it is quite easy to construct mathematical hypotheses, which will invest experimental data with a seductive appearance of mathematical precision, and bring them to the support of a great variety of physiological hypotheses. What is not, we think, so commonly realized is that conditions necessary to give reality to these expedients have not been fulfilled. Such observations as those of Brezina and Kolmer cover a sufficient range, but provide an insufficient number of individual experiments; our own data (which were naturally not collected *ad hoc*) afford sufficient experiments but an inadequate range of points. Until both desiderata are fulfilled, in one and the same experimental series, efforts to express the fundamental physiological law in a quantitative form must be in vain. Yet the problem here touched on is not only of great practical importance, but evidently capable of solution.

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DYSENTERY AND ENTERIC DISEASE IN MESOPOTAMIA FROM THE LABORATORY STANDPOINT.

An Analysis of Laboratory Data during the Eighteen Months ending December 31, 1918.

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(*Continued from p.* 203.)

Consideration of Individual Charts.

[1] *Chart* 1 *: Dysentery, British Force.*—A glance at the lower segments shows that, as the general incidence increases, the amœbic incidence also increases a little but to a degree out of all proportion to the general dysenteric increase. The amœbic incidence, in fact, follows the course of the general incidence fairly closely, but at a much lower level. Consequently the epidemic periods cannot be explained by any undue excess of amœbic infections whatever the remaining portions of the columns may be taken to represent (on this point see below). The only month in which amœbic incidence, though minimal, is high in proportion to the general incidence, is February, in which month, however, the figures on which the percentage is based are very low. Nevertheless, it is possible that in epidemic-free periods the usually fairly constant amœbic percentage rises unduly, and I am inclined to think that this may be occasioned, not so much by fresh amœbic infections, as by relapses following, perhaps, climatological changes (see below in connexion with humidity question).

The following analysis shows, perhaps, in a more succinct form, the role of amœbic infection in British dysentery in Mesopotamia :—

	Average general incidence per 10,000	Amœbic general incidence per 10,000
Last Quarter, 1917..	83·3	22·0
First Quarter, 1918	15·1	5·53
Second Quarter, 1918	48·5	10·76
Third Quarter, 1918	35·3	10·01
Fourth Quarter, 1918	73·03	16·60

Chart 3 *: Dysentery, Indian Force.*—We note that the amœbic incidence again follows very closely the general incidence and that amœbic infection

[1] In all charts the complete column represents total incidence per 10,000 per month. The lower segment represents amœbic incidence per 10,000. In charts, the columns of which contain three segments, the middle segment represents proved bacillary incidence per 10,000. Upper segment in all cases represents incidence of non-amœbic but otherwise unproved cases.

plays a very appreciably greater role in Indian than in British dysentery. The months of highest relative amœbic incidence are February, June, July and October. These charts for the Force are not, however, so valuable as those for areas and it will be well to make any detailed analysis on areal figures only.

Chart 4*: British, Forward Area.*—In the Forward Area, British amœbic incidence is very low and very clear evidence is available of the negligible part played by *E. histolytica* in the spring and autumn outbreaks. We see at a glance that, during the epidemic periods, the amœbic portion of the columns remains practically constant, indicating a simultaneous fall in the relative amœbic percentage. When the epidemic ceases, the amœbic percentages quickly reach their usual level of about twenty per cent. We shall return to this chart when we come to consider the non-amœbic portions of the columns; but one might note again here that the month in which amœbic infection actually predominates (relative incidence 52·7 per cent) is February. In no other month is any approach to that figure attained.

Chart 5*: Indian, Forward Area.*—Here one observes the great role played by amœbic infections. During the six months, February to July, amœbic infections form by far the major portions of the columns. In the August rise, however, and during the epidemic months of November and December, there is a distinct fall of the amœbic percentage to minimal levels. Indian epidemic dysentery in the strict sense is not, any more than British, occasioned by *E. histolytica* but there is no question that what might be termed "continued high endemic Indian dysentery," is mainly of amœbic origin in the Forward Area.

Chart 7*: British, Basra.*—Here we meet a somewhat different state of affairs from that in the Forward Area. Again the spring epidemic in May and June, and especially in May is essentially non-amœbic in character, while the November outbreak is characterized by a big fall in the relative amœbic incidence. During December, 1917, March, August and December, 1918, amœbic infection predominates and forms from one-half to three-quarters of the total dysentery incidence. I am inclined to think that British ranks in Basra must have become fairly highly parasitized with *E. histolytica*, and that much of the amœbic dysentery among them is of an endemic order with a high percentage of relapse cases.

Chart 8*: Indians, Basra.*—While the relative incidence of amœbic infection in British at Basra is high, that of Indians is very low. The only month in which amœbic infection predominates is July. The state of affairs from March to October is interesting. These months may be taken as representing the spring-summer epidemic wave.

In April the amœbic incidence is at its lowest (seventeen per cent), and this is the only month in which a marked increase in the general incidence occurred. As the "epidemic" continues, *E. histolytica* becomes increasingly frequent and actually predominates in July. On the whole,

however, the Indian at Basra is undoubtedly less subject to amœbic infections that bring him to hospital than the British soldier at Basra. It has to be remembered that much of the Indian population at Basra is a migratory one, on its way up the line. Labour corps cases are also included in the Indian returns and in every way less reliable deductions are to be drawn from this area with regard to dysentery prevalence than from any other, owing to the heterogeneity of its population.

Charts 9 to 14 dealing with diarrhœal diseases (i.e., dysentery + diarrhœa + colitis) have been compiled in the same way. I do not propose to comment on these charts which exhibit variations in amœbic incidence parallel to those for dysentery only, but I append some data showing the average amœbic percentage in B. and M. and non-B and M. cases at Baghdad and Basra for the period January to December, 1918.

British	*E. hist.* percentage
Baghdad, B. and M. cases (total, 1841)	18·1 per cent.
Basra, B. and M. cases (total, 724)	40·7 ,,
Baghdad non-B. and M. cases (total, 2,750)	12·5 ,,
Basra, non-B. and M. cases (1,555)	16·2 ,,
Indians	***E. hist.* percentage**
Baghdad, B. and M. cases (total, 1,238)	46·6 ,,
Basra, B. and M. cases (total 1,378)	33·7 ,,
Baghdad, non-B. and M. cases (total, 1,774)	14·9 ,,
Basra, non-B. and M. cases (total, 1,809)	6·9 ,,

The total amœbic percentage for all cases taken together, B. and M. and non-B. and M., was as follows:—

	British	Indians
Baghdad ..	14·8 per cent. ..	27·9 per cent.
Basra.. ..	24·4 ,, ..	18·5 ,,

B. Dysenteriæ.

Charts 2, 4 and 6 have their columns divided into three portions. The middle segments represent proved *B. dysenteriæ* infection.

The figures are calculated from the percentage of non-amœbic B. and M. cases yielding *B. dysenteriæ* and strictly on the basis of numbers submitted to plating. When amœbic and non-amœbic B. and M. cases have both been plated with the object of demonstrating mixed infections, the calculation is based on the difference between the non-amœbic and the number plated.

These charts speak for themselves and require little comment. Naturally the best data are obtained from first-class laboratories attached to British hospitals where the great majority, if not all, of the non-amœbic dysenteries were plated. (Of 2,397 British non-amœbic cases, 2,235 or 93·2 per cent were plated.)

I quote in their entirety the figures for one British Baghdad hospital dealing with dysentery cases from the Forward Area.

Month		B. and M. cases	*E. hist.*	*B. dysent.*	Total diagnosed
October,	1917	120	49	8	57
November,	,,	170	48	20	68
December,	,,	64	15	30	45
January,	1918	46	13	7	20
February	,,	20	10	3	13
March	,,	23	2	8	10
April	,,	48	1	11	12
May	,,	59	6	16	22
June	,,	74	8	20	28
July	,,	48	19	7	26
August	,,	48	14	17	31
September	,,	78	24	26	50
October	,,	57	12	27	39
November	,,	130	22	58	80
December	,,	57	11	21	32
Totals		1,042	254	279	533

From this table it appears that a diagnosis was established in 51·1 per cent of all the B. and M. cases submitted throughout the year. Cultural results were most successful during the two epidemic seasons and actually showed a great preponderance of *B. dysenteriæ* infections over *E. histolytica* infections. Thus, in the spring outbreak the proportion of *E. histolytica* to *B. dysenteriæ* was as 1 : 3·1, and in the autumn epidemic as 1 : 2·3.

In November there were forty-nine undiagnosed B. and M. cases. The medical officer in charge provided a classification of these, based on the clinical course, temperature charts, response to treatment, etc., and on the macroscopical and microscopical appearance of the motions. It was as follows :—

Bacillary type	34
Amœbic type	4
Doubtful (mild clinically)	11

Shiga and Flexner.

Of 715 isolations of *B. dysenteriæ* in British troops, *B. shiga* was recovered in 45·3 per cent and *B. flexner* in 54·7 per cent. Though figures are small, it may be noted as a point of interest that the one quarter of the year in which Shiga infections exceeded Flexner infections was the third quarter (especially August). In that quarter the case mortality from British dysentery was also highest, viz., 3·39 per cent. (Case mortality for fifteen months ending December, 1918, was 1·74 per cent—8,275 cases with 144 deaths.)

In the spring outbreak Shiga infections predominated in May and they also predominated in October. In the non-epidemic period of January to March Flexner infections predominated, a fact which may have some bearing on the very low case mortality in that quarter, viz., 0·73 per cent. There is some evidence that during the rise of an epidemic Shiga infections

predominate with consequent increased mortality, while during the decline of the outbreak Flexner infections accompanied by diminished mortality take their place. I do not lay any great stress on the inference, however, as the high mortality in the third quarter may have been associated with complications of a varied character—heat, difficulty of transport, delayed specific treatment, etc.

In Indian dysentery our data as to the presence of *B. dysenteriæ* are not so complete as one would wish, and it would appear that the chance of demonstrating *B. dysenteriæ* in the stools of non-amœbic Indian dysenteries, is much smaller than in British. The central laboratory, Baghdad, for the six months, July to December, 1918, had a percentage of 49·8 per cent of successful isolations in British cases, but only 22·9 per cent in Indian cases. If to these we add the data from the only first-class Indian laboratories in the area (9 Indian General Hospital and 12 Indian General Hospital) we find that out of a total of 365 non-amœbic Indian dysenteries, submitted to plating, *B. dysenteriæ* was recovered in 85 or 23·2 per cent. Of this total, Shiga formed 37 per cent and Flexner 63 per cent, thus showing a somewhat higher proportion of Flexner infections than the British. The Indian mortality works out at 3·38 per cent (7,099 cases with 240 deaths), i.e., very nearly double the British rate. The highest Indian mortality rate occurred in the spring epidemic, viz., 6·14 per cent.

These mortality statistics are interesting from another point of view. The official statistics show that, of a total of 6,927 British cases of colitis and diarrhœa (January to December, 1918), only ten died, giving a case mortality of 0·144 per cent, while of 7,286 Indian cases of colitis and diarrhœa, no less than 195 died, thus yielding a case mortality of 2·67 per cent, which approaches closely that from notified Indian dysentery.

The suggestion is that the great majority of the British cases returned as colitis and diarrhœa are genuinely trivial disturbances, while many of the corresponding Indian notifications should more properly (if the death-rate is any guide) have come under the category of genuine dysenteric infections. It is unfortunate that diseases returned simply as diarrhœa or colitis should have a death-rate at all, and it throws a strong light on the looseness of official nomenclature in the notification of diarrhœal disease. In the light of recent work by Major Cunningham, I.M.S. (1918), on what he terms "latent" dysentery, it is possible that much of the diarrhœal disease in Indians represents recrudescences of latent dysentery—a condition which may be detectable only after repeated naked-eye examination of the motions and may be compatible with fair health. Cunningham found that no less than twenty-two per cent of the Indian jail population suffer from latent dysentery and that it is the import of such cases into jails which accounts for the continued prevalence of dysentery and diarrhœa in such institutions. In Indian jails diarrhœa has a death-rate, though very small in comparison with that from dysentery. The relatively high mortality from diarrhœal disease in Indians on service is probably due

largely to pulmonary complications, but on this point clinical data are required. For my own part, when visiting dysentery and diarrhœa wards of Indian hospitals, I have always been struck by the fact that the great majority of the cases are sitting up in bed or amusing themselves on the floor. The contrast with a British dysentery ward in the epidemic season is remarkable.

Atypical Dysentery Strains.

The dysentery strains forming the basis of the foregoing analysis have all been typical in so far as their reaction to Shiga and Flexner-Y sera is concerned. Occasionally in all laboratories inagglutinable strains chiefly of the mannite-fermenting type have been recovered, many of which have, after repeated subculture, regained their agglutinability. Such strains, however, have not been frequent, and in the epidemic season they appear to play a very small rôle indeed. It would be of great interest to determine whether these atypical varieties are associated with special clinical types, perhaps of a milder order, and whether, in the course of convalescence from dysentery known at the commencement to be due to typical strains, the latter may undergo changes in their serological affinities rendering them "atypical." That this occurs in cholera, and that cholera-like vibrios are most prone to occur in the last stages of a cholera outbreak has been suggested by Greig [1918].

Flagellate Infections.

Opinion has not yet crystallized on the question of the pathogenicity of flagellates met with in dysenteric and diarrhœal stools. I therefore propose to record simply the figures dealing with the frequency of flagellate infections (whether pure or mixed) and the frequencies of the three most commonly encountered species.

Proportion of B. and M., and Non-B. and M. Cases yielding Flagellates.

	B. and M. cases		Non-B. and M. cases		All cases	
	B.	I.	B.	I.	B	I.
4th quarter, 1917	9·1 per cent	4·9 per cent	19·5 per cent	14·9 per cent	17·1 per cent	9·8 per cent
1st ,, 1918	9·8 ,,	9·9 ,,	16·4 ,,	17·4 ,,	15·3 ,,	15·6 ,,
2nd ,, ,,	8·5 ,,	10·3 ,,	14·4 ,,	17·7 ,,	12·4 ,,	15·4 ,,
3rd ,, ,,	13·6 ,,	20·3 ,,	24·4 ,,	13·1 ,,	20·9 ,,	14·9 ,,
4th ,, ,,	10·5 ,,	10·5 ,,	24·7 ,,	11·8 ,,	18·1 ,,	11·2 ,,

PERCENTAGE OF THE THREE GROUPS.

(T.C. = Total cases yielding data. L. = Lamblia. Tr. = Trichomonas. Tet. = *Tetramitus mesnili*).

	T.C.		L.		Tr.		Tet.	
	B.	I.	B.	I.	B.	I.	B.	I.
4th qtr., 1917	5,378	1,316	7·9 per cent	4·9 per cent	6·6 per cent	5·0 per cent	4·7 per cent	1·0 per cent
1st qtr., 1918	1,744	1,134	7·5 ,,	7·1 ,,	3·7 ,,	8·1 ,,	6·5 ,,	3·7 ,,
2nd ,,	2,922	1,836	4·9 ,,	5·4 ,,	5·8 ,,	11·1 ,,	4·3 ,,	4·6 ,,
3rd ,,	2,183	1,878	7·3 ,,	4·5 ,,	9·9 ,,	10·3 ,,	6·9 ,,	4·3 ,,
4th ,,	3,464	1,782	5·4 ,,	3·9 ,,	10·8 ,,	6·6 ,,	4·3 ,,	2·9 ,,

also append the quarterly figures obtained at one British hospital aboratory (32 British General Hospital, Amara), the work being performed throughout by an experienced protozoologist (Captain Lepage, R.A.M.C.).

	T. C.	L.	Tr.	Tet.
4th quarter, 1917	1,365	11·7 per cent	7·1 per cent	7·1 per cent
1st quarter, 1918	378	16·9 ,,	5·8 ,,	8·2 ,,
2nd ,, ,, ...	589	9·3 ,,	5·2 ,,	4·5 ,,
3rd ,, ,, ...	378	12·4 ,,	11·1 ,,	10·5 ,,
4th ,, ,, ...	225	4·4 ,,	5·7 ,,	6·6 ,,

FLY PREVALENCE AND DYSENTERY PREVALENCE.

In Mesopotamia there are two seasons of fly prevalence which correspond fairly closely in time with the spring and autumn dysentery seasons. Through the kindness of Lieutenant-Colonel Scroggie, C.I.E., I.M.S., I am able to give the figures for fortnightly catches of flies taken by him in a Balfour fly-trap during the period November, 1916, to September, 1918. These figures have been charted in Chart 1 (below base line), so that they may be superposed if desired on the upper portion of the chart representing dysentery in the Force. For charting purposes, the fly figures are reduced.

Naturally the figures for dysentery and diarrhœa incidence at Amara, where these records were made, should more properly have been brought into relation with the Amara fly prevalence, but these figures are of too small an order for this purpose. Amara occupies a central position in Mesopotamia, and its local fly seasons will serve very well to typify fly conditions in that country.

Without straining what, on even casual inspection, would appear to be an extraordinarily close correspondence in time of the two prevalences, there are certain points which require notice. Practically no flies (our records state 0 or less than 50) are caught during the first quarter of the year.

The first broods appear in the last fortnight of March or the first fortnight of April, and the maximal catches are recorded in the last fortnight of April or the first fortnight of May. During July and August, the hottest months of the Mesopotamian year, the flies all but disappear, to reappear again in the last fortnight of September or the first fortnight of October. The autumnal fly prevalence has its maximum in the first or second fortnight of November. The almost complete disappearance of flies in the hot months is not accompanied by any proportionate fall in the dysentery prevalence which, as already mentioned, returns only to the April level. Other factors than flies must play the more important role in distributing infection during this period. My suggestion is that the mass of fresh infections established in the spring outbreak largely by the agency of flies, leaves behind it a large amount of chronic and carrier infection which, aided by weather conditions favouring intestinal disturbance, serves to maintain the dysentery and diarrhœa incidence at a fairly constant level till the next fly outburst initiates the autumnal mass of fresh infections.

Humidity and Amœbic Prevalence.

Woodcock (1919) working in the Suez Canal zone, has published some evidence suggesting that increased amœbic prevalence is associated with an increase in the relative humidity of the atmosphere, and that in the distribution of amœbic infection, flies play a very subordinate rôle in comparison with contaminated water, fouled vegetables and fruit, etc. He adds, "It would be useful to have data corresponding to those which I have given above, from workers in the military laboratory in Mesopotamia. Owing to the intense relative humidity of that country during certain seasons, one would expect to find a distinctly higher percentage of amœbic infections amongst the British troops there than has been met with in any part of Egypt." That the percentage of amœbic infections in Mesopotamia is higher than in the Canal zone is true; Woodcock's range of percentage of amœbic infection in acute dysentery of British troops is 2·5 per cent to 20 per cent. In Mesopotamia, taking the Forward Area statistics for British troops, the range of percentage of amœbic infection is five per cent to fifty per cent, the latter occurring, as already mentioned, only in one month (February). The range of relative humidity covered by Woodcock's data is a small one—seventy per cent to eighty per cent, and he is evidently under a misapprehension with regard to the "intense relative humidity" of Mesopotamia.

Chart 15 shows the monthly mean relative humidity at Baghdad recorded at 8 a.m., and at 4 p.m., during the period September, 1917, to January, 1919, also the mean daily maximum temperature at Baghdad and the percentage of *E. histolytica* infection in British acute dysentery of the Forward Area. For the meteorological data I am indebted to the Officer in Charge of the Weather Bureau, Baghdad.

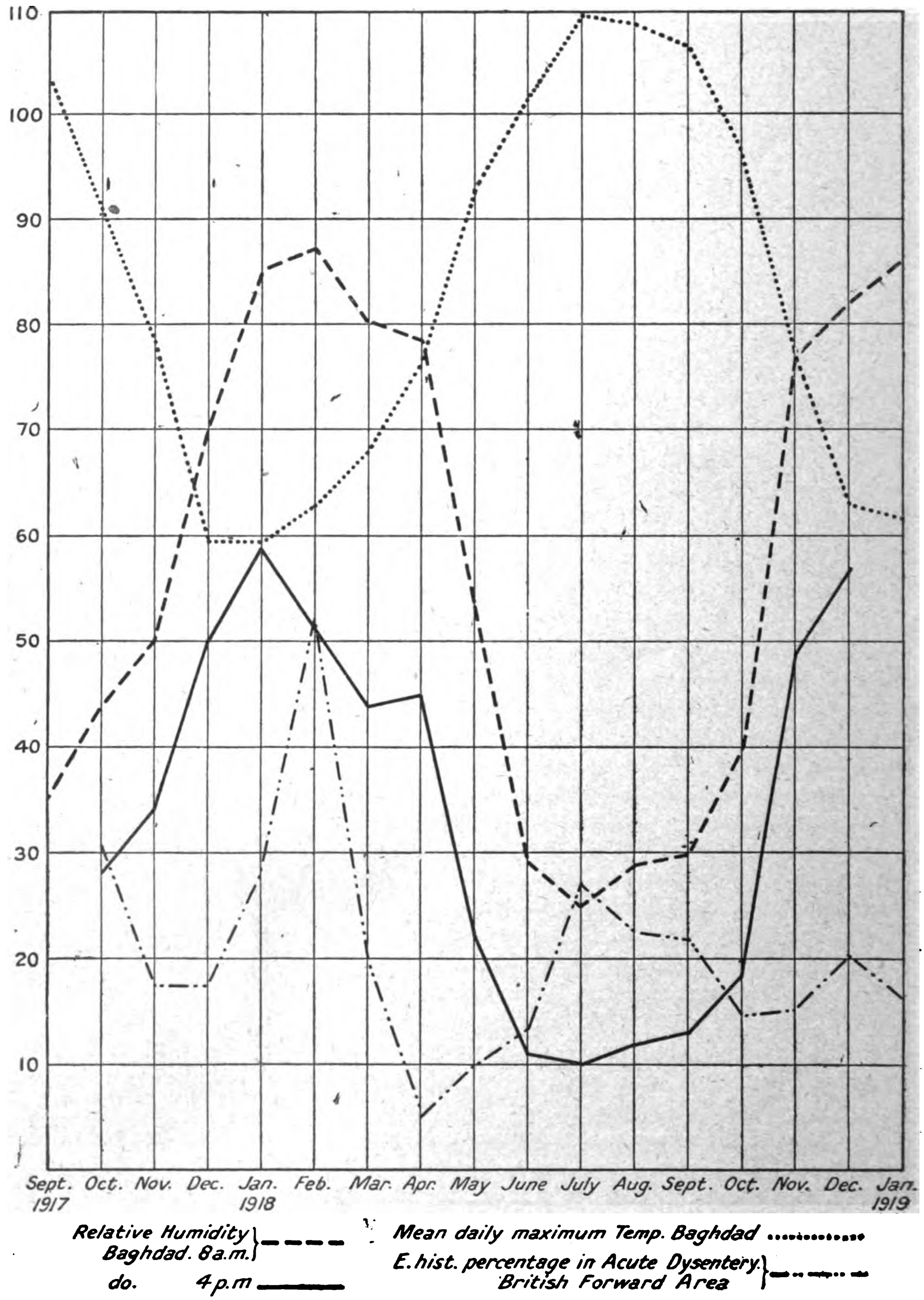
110
100
90
80
70
60
50
40
30
20
10
Sept. 1917
Oct.
Nov.
Dec.
Jan. 1918
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
Jan. 1919
Relative Humidity Baghdad. 8 a.m.
do. 4 p.m
Mean daily maximum Temp. Baghdad
E. hist. percentage in Acute Dysentery. British Forward Area

Chart 15.

The relative increase of amœbic infection occurring in February at a time when dysentery incidence is minimal, is contemporaneous certainly with the period of high relative humidity, but it appears to be merely an ephemeral increase, and the minimal amœbic percentage is reached at a time (April) when the relative humidity is still high. From April to July the relative amœbic prevalence rises while the relative humidity is rapidly falling to its lowest point in July, the hottest month of the year. The higher percentage of amœbic infection in British troops in Mesopotamia is almost certainly due to intimate association with a large mass of Indian and probably also native amœbic infection. What factors determine the variation in the incidence of amœbic infection throughout the year remain at present somewhat obscure. As the charts in this survey show, amœbic incidence per 10,000 follows fairly closely the seasonal variations in the general dysentery incidence, and until we know more with regard to the life history of pathogenic amœbæ and the factors which determine that amount of pullulation in the body of the carrier host which will cause obvious clinical disease, the problem must remain unsolved.

Enterica.

On the suggestion of the Medical Advisory Committee in 1916, attempts to diagnose the specific enterica infections by agglutination tests in troops inoculated with the triple vaccine, were officially discouraged. Every effort was therefore made to concentrate on isolation of the infecting organism whether from blood, fæces, urine, or other sources. Consequently only two groups of statistics come under review, viz. (1) Enterica confirmed by isolation of the organism whether T., A. or B. and (2) Clinical Enteric Group or E.G.

The official notifications of Confirmed Enterica and Clinical E.G. for the period October, 1917, to December, 1918 (adjusted for calendar months) are as follows :—

	Confirmed		E.G.		Total Notifications	
	B.	I.	B.	I.	B.	I.
October, 1917	47	15	124	19	171	34
November ,,	34	22	82	21	116	43
December ,,	49	17	53	27	102	44
January, 1918	27	11	43	6	70	17
February ,,	11	5	22	10	33	15
March ,,	15	12	18	20	33	32
April ,,	11	15	10	10	21	25
May ,,	13	23	38	16	51	39
June ,,	20	29	39	14	59	43
July ,,	26	44	51	21	77	65
August ,,	31	37	13	21	44	58
September ,,	29	34	84	25	113	59
October ,,	27	21	43	10	73	31
November ,,	17	11	18	2	35	13
December ,,	27	8	17	9	44	17

The total notified confirmed cases amount to 688 but this is probably an under-estimate as the laboratories record in the same period 734.

Taking the figure 734 as the more accurate one we note that of the total notified entericas during fifteen months, 46·6 per cent have been bacteriologically confirmed by isolation of the infecting organism. Of the total 1,039 British cases 384 or 36·9 per cent were confirmed while of the 535 Indian cases 304 or 56·8 per cent were confirmed. The differeuce is striking and requires some comment. It holds good in all areas as the following figures show :—

	Confirmed B.	Confirmed I.	Total cases
Advanced Section ..	38·2 per cent	44·2 per cent ..	831
Amara	50 ,,	78·4 ,, ..	152
Base	40·09 ,,	66·9 ,, ..	303

Only two Indian hospitals were provided with first-class laboratories while the others sent their material for diagnosis to central laboratories. One would therefore expect that under such circumstances the proportion of confirmed cases to the total notifications would be lower than in the British. That the reverse occurs is accounted for probably by a variety of causes. (1) In Indian hospitals, the mere fact that bacteriological diagnosis must be attempted, perhaps repeatedly, has the probable effect of limiting enterica notification mainly to such as have been bacteriologically confirmed, (2) Enterica in Indian troops was regarded, at least at the commencement of the campaign, as an infrequent occurrence. I used frequently to hear the statement made by Indian medical officers that Indians do not readily contract enterica, the reason alleged being that they were immune from having had the disease in infancy.

The holding of such views would naturally tend to diminish the number of notifications of Clinical Enteric Group where the clinical diagnosis was doubtful and bacteriological results (if any) were negative. (3) There is a third possibility and I am inclined to attach considerable importance to it. It depends on the following data :—

Of 384 confirmed British entericas, there were 123 T., 218 A. and 40 B.; while of 304 confirmed Indian entericas there were 158 T., 97 A. and 48 B. Typhoid fever has therefore been considerably more frequent relatively to paratyphoid in Indians than in British. I have examined on this point the figures from July, 1916, to November, 1918.

	Confirmed	E. G.	T. per cent	A. per cent	B. per cent	Death-rate
British (Force).						
July to December, 1916	446	1,018	12·3	74·4	13·2	10·9
January to June, 1917	101	239	8·9	77·2	13·8	7·3
July to December, 1917	197	544	21·3	72·5	6·0	8·2
January to June, 1918	101	170	36·6	50·4	12·8	4·0
July to December, 1918	127	209	37·7	47·2	14·9	16·9
Indians (Force).						
July to December, 1916	89	218	29·2	59·5	11·2	14·6
January to June, 1917	69	162	17·3	78·2	4·3	10·3
July to December, 1917	101	156	45·5	46·5	7·9	20·6
January to June, 1918	96	75	53·1	32·2	14·5	20·4
July to December, 1918	147	80	52·3	30·6	17·0	22·0

It would appear from these figures that in the period July 1916 to June 1917, the enterica both in British and Indians was predominantly Para. A,

though less so in Indians than in British. From July, 1917, to November, 1918, para. A has relatively declined and though the former is still (December, 1918) about 10 per cent more frequent relatively than typhoid fever in British, it now takes very much second place to typhoid fever in Indians. Also it will be noticed that there has been a change in the general case mortality. The case mortality of confirmed and E.G. cases is of great comparative interest.

Case Mortality.

	British	Indian
T. cases	11·4 per cent	27·2 per cent.
A. ,, ...	3·3 ,,	11·3 ,,
B. ,, ...	7·5 ,,	16·6 ,,
E.G. cases	10·0 ,,	20·7 ,,

General Enterica case Mortality: B. 8·7 per cent, I. 20·5 per cent.

Thus Indian case mortality from		T. is 2·3 times that from British			T.
,,	,,	A. ,, 3·1	,,	,,	A.
,,	,,	B. ,, 2·2	,,	,,	B.
,,	,,	E.G. 2·7	,,	,,	E.G.

How far prophylactic inoculation in British and Indians bears on this question I cannot discuss as I do not possess the necessary data.

I suggest simply that enterica has run on the whole a graver course when it has attacked Indian than when it has attacked British troops. This circumstance, though perhaps not affecting very materially the chances of bacteriological success in effecting diagnosis, would tend to the substitution of some non-enterica diagnosis for cases which, had they been British, would have been returned as Clinical E.G. in spite of negative bacteriological results.

Paratyphoid C Fever.

I require simply to mention here the demonstration in Mesopotamia of a new variety of paratyphoid organism, undoubtedly allied to para. B but serologically distinct from it. The work dealing with this question by Mackie and Bowen (1919) and by MacAdam (1919) has already appeared and the organism in question has been found to be identical with a similar organism isolated in Macedonia during the war. The new variety would seem to be an Eastern variant of para. B. and I have lately received a strain from German East Africa.

In conclusion, I wish here to express my gratitude to the Bacteriologists of the Mesopotamian Expeditionary Force for their hearty co-operation and to the Medical Headquarters Staff for the facilities given me in connexion with the compilation of this survey.

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MacAdam, W. Journal of the Royal Army Medical Corps, vol. 33. p. 140.
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APPENDIX I.

DYSENTERY, DIARRHŒA AND COLITIS INQUIRY FORM.

(Only for Local Admission and Transfers arriving with no laboratory documents.)

Total No. of individual cases examined..........
No. of cases the stools of which contained B. and M...........
No. of B. and M. cases examined microscopically..........
No. of do. bacteriologically..........
No. of cases not showing B. and M. examined microscopically..........
No. of do. bacteriologically..........
No. of cases diagnosed post mortem..........Amœbic..........Bacillary..........

RESULTS.	B. and M.	Non-B. and M.	
Cases yielding:—			
1. *E. histolytica* free with or without cysts ...	....	....	....
2. *E. histolytica* cysts without free forms ...	....	....	....
3. *B. dysenteriæ* (Shiga)	....	....	....
4. *B. dysenteriæ* (Flexner-Y)	....	....	....
5. Mixed Shiga and Flexner	....	....	....
6. Atypical *B. dysenteriæ* (inaggl.)	....	....	....
7. Mixed *E. histolytica* and *B. dysenteriæ* ...	....	....	....
8. *B. Morgan*, *B. Gaertner*, etc.	....	....	....
Additional	Protozoological Findings.		
9. *E. coli* cysts with or without free forms ...	....	....	....
10. *E. coli* free without cysts	....	....	....
11. Undiagnosed entamœbæ	....	....	....
12. Lamblia	....	....	....
13. Trichomonas	....	....	....
14. Tetramitus	....	....	....
15. Balantidium	....	....	....
16. Coccidia	....	....	....
17. Other Protozoa...	....	....	....
18. Total No. of cases of flagellate infection, whether pure or mixed	....	....	....

No. of cases reported as negative last month and now found to be positive..........
E. histolytica..........*B. dysenteriæ*..........

Information with regard to Transfer Dysentery and Diarrhœa cases bearing documents of previous laboratory examination and now re-examined.

No. of such cases re-examined..........

No of such cases in which a positive diagnosis of *E. histolytica* or *B. dysenteriæ* has now been made while previous examinations in other laboratories were negative..........
E. histolytica.......... *B. dysenteriæ*..........

APPENDIX II.

Lab. Form No. 6.

Laboratory Returns.

Note on Rulings, for Guidance in Entering the Monthly Laboratory Returns.

(1) *Rulings applying to Special Dysentery and Diarrhœa Form.*

(*a*) This form is to be used for recording results in the following cases only: (1) Local admissions. (2) Transfer cases from other hospitals, with no record of any previous laboratory examination. (N.B.—Results obtained by re-examination of cases transferred from other hospitals, with certificates recording previous laboratory examinations, are not to be entered here.)

(*b*) The cases dealt with in this form are understood to be suffering from dysentery, colitis and diarrhœa. If casual positive findings of *E. histolytica* are obtained in the course of examination of excreta of patients suffering from other diseases, e.g., helminthiasis, or from patients giving no history of dysentery, past or present, they are not to be entered here, but are to be recorded specially in the commentary with notes as to the total number of cases examined, and the number of ditto which yielded *E. histolytica.*

(*c*) Where several examinations are made in any one case by *the same observer* and a positive finding of *E. histolytica* or other protozoon is obtained in a *non-B. and M.* sample, while a previous *B. and M.* sample had proved negative, the case is to be entered as a *B. and M.* case yielding *E. histolytica* or other protozoa.

(*d*) A *B. and M.* case is one, the stools of which consist of blood and mucus macroscopically, or which is found to contain blood and pus on microscopical examination. Stools containing mucus only are to be entered as *non-B and M.*

(*e*) Free forms of *E. histolytica* are always understood to mean motile forms containing red cells.

(*f*) Where positive results are obtained in cases returned as negative in the previous month's return, the results in so far as they contain *E. histolytica* or *B. dysenteriæ* should be stated in the space provided, so that the proper correction may be made. The results should, however, be entered as well in the tabular statement under the appropriate headings.

Protozoal findings other than *E. histolytica* need not be entered in such carry over cases unless the pathologist desires to do so in the commentary.

(*g*) In cases of mixed protozoal infection, each protozoon is to be regarded as a separate infection. Thus, if three types occur in one stool, e.g., *E. Coli*, *Trichomonas*, *Coccidium*, this case would be entered three times, once under *E. Coli*, once under *Trichomonas*, and once under *Coccidium*. With regard to No. 18, each flagellate case is treated separately and only entered once apart from the infection being pure or mixed. If mixed flagellate infections occur, the entries for No. 18 will add up to less than the sum of the entries for Nos. 12, 13 and 14.

(*h*) With regard to No. 6, a note of the chief characters of these forms should be appended.

(*i*) With regard to No 8, it is understood that neither *E. histolytica* or *B. dysenteriæ* is present in the stool in question.

(2) *Rulings applying to Transfer Cases bearing Documents of Previous Laboratory Examinations.*

(*a*) The only information desired with regard to these cases is the following: (1) Number of such cases re-examined. (2) Number of such cases (hitherto negative) in which a positive diagnosis of *E. histolytica* has been made. Space is provided for this information on the form. These cases will, however, appear also in the Tabular Statement under the appropriate headings. Special arrangements will be made for collecting the bacteriological data which accumulate in connexion with these transfer cases down the L. of C.

APPENDIX III.

Lab. Form No. 1.

DYSENTERY, DIARRHŒA AND COLITIS.

This form is to accompany case on transfer and any further reports that may be made on examinations of excreta are to be recorded in the spaces below.

Number, Rank, Name and Unit ....

Date of commencement of illness ....

Medical unit to which case was first admitted ....

Clinical diagnosis at ditto ....

Character of motion when seen by Medical Officer at ditto ....

Medical unit at which this form started ....

PATHOLOGICAL REPORTS.

Medical unit and date of admission	Hospital No.	Laboratory No.	Dates of samples	Character of stool	Findings *E. hist.* or *B. dys.*	Emetin or Serum with doses and dates	M.O. Sig.	Path. Sig.

S.G.P.Bd....1451...2261...3000...2-4-18.

"THE USE OF NORMAL HORSE SERUM INOCULATION IN THE TREATMENT OF SEPSIS."

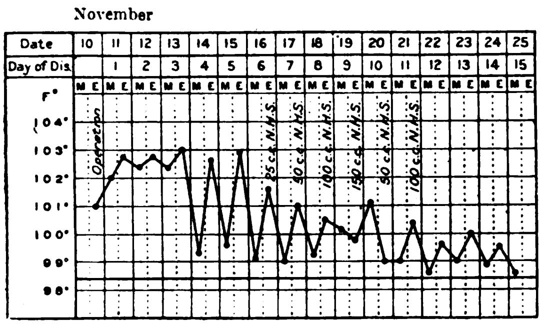
By E. EMRYS-ROBERTS, M.D.

In 1906 Paton [1] strongly advocated the use of anti-diphtheritic serum in septic conditions generally. Later he affirmed that normal horse or ox serum was equally effective. He further claimed that normal horse serum was also valuable in the treatment of tuberculosis, arthritis deformans, broncho-pneumonia, dysmenorrhœa, nephritis, cerebro-spinal meningitis, epilepsy, Graves' disease, traumatism, and other conditions, a list which drew forth caustic criticism from Bosanquet and Eyre [2].

In 1911 Horder [3], in the course of a discussion, said that normal horse serum was of service in most acute infections, and that he used it commonly in such states pending the result of bacteriological investigations, being convinced that it exercised at times a powerful stimulation to increased resistance in some infective processes. Curiously, he considered it probable that the non-specific action of N.H.S. in inhibiting the growth of bacteria, or in neutralizing their toxins in infective processes, was bound up in the metabolic disturbances set up about the ninth day of its administration. In the course of the same discussion Hort [4] stated that he was satisfied that N.H.S. inoculation was of value in cases of severe hæmorrhage, in which a toxic basis might be held responsible. He also stated that the anti-toxic properties of N.H.S. were very noticeable, especially in inhibiting the toxic action of extracts of normal tissues which, when injected without the serum, were intensely toxic.

My first experience in the use of N.H.S. inoculation in the treatment of sepsis occurred in September, 1916, when I was asked by Captain John Fraser, M.C., R.A.M.C., to see a man suffering from extensive wounds, with gas gangrene infection and a possible septicæmia, with a view to obtaining a blood culture. On my arrival, however, at the casualty clearing station the condition of the man was such that it was impossible to obtain the requisite amount of blood, so the syringe and media were left in order that a specimen of the heart's blood might be obtained, there being every reason to suppose that death was merely a matter of a few hours. Before leaving I was asked if I could suggest any possible form of treatment. I proposed the inoculation of 50 cubic centimetres N.H.S. subcutaneously, which Captain Fraser consented to give. The following day, the specimen of blood not having arrived, I rang up to find that the man was still alive, so a dose of 100 cubic centimetres was suggested. This was followed up by 150 cubic centimetres the next day, and 200 cubic centimetres the day following, and it was satisfactory to learn that, in the course of a fortnight, the man was well enough to be sent down the line.

The next case—also one under the care of Captain Fraser—was in November, 1916, and I am indebted to Captain Fraser for the notes he kindly sent me. Pte. A. H. was admitted to the casualty clearing station with severe compound fracture of the right leg, involving the knee-joint and, at a lower level, both bones of the leg. There was an acutely-spreading gas-gangrene infection. Immediate operation was performed—an amputation in the mid-thigh area. Owing to the presence of infection the flaps could not be closed. A number of dry leather-like sloughs formed over the greater part of the area of the stump, and well beneath these sloughs there was considerable suppuration. On the third day after admission the temperature, which had remained high (103° F.) began to swing. On the sixth day, November 16, the patient's general condition became much worse, the pulse greatly increased in rate, there was sickness,



and at times he became almost comatose. The breathing curiously altered, and there were intervals of deep sighing respiration. On this day Captain Fraser asked me to see the patient, primarily to discuss the advisability of giving him antistreptococcal serum. I persuaded him to rely on N.H.S. alone, so he first gave 1 cubic centimetre intradermically as a desensitizing dose, and two hours later, in the absence of local reaction, followed it up by 25 cubic centimetres subcutaneously. On November 17, 50 cubic centimetres was given, on the 18th 100 cubic centimetres, on the 19th 150 cubic centimetres, on the 20th 50 cubic centimetres, and on the 21st a further 100 cubic centimetres. It was recognized that, within a few hours of the first massive injection, there was an improvement in the man's condition; he became distinctly more conscious, and the pulse rate began to fall. From this point there was a steady improvement, both in the general and the local condition, the flaps rapidly cleaned up and the temperature and pulse became settled. The improvement was maintained, and the patient was evacuated on the 25th, nine days after the first inoculation.

The third case—again one of Captain Fraser's—was that of Pte. R. admitted to the casualty clearing station with a severe wound of the right

shoulder, and almost complete division of the arm from the body. As the limb was already showing signs of gas-gangrene, amputation was performed at the shoulder-joint. The flaps, which were left open, were soon covered with brown leathery sloughs; the temperature became hectic in type. N.H.S. was given, exactly as in the previous case, with a single desensitizing dose and similarly succeeding massive injections. Subsequent improvement was marked and progressive.

These results, and others equally encouraging obtained by Captain E. M. Cowell, R.A.M.C., led me to believe that something more than mere coincidence lay behind the inoculation of N.H.S. in massive doses in the treatment of grave conditions arising from wound sepsis.

An opportunity presented itself when, in the autumn of 1918, I was stationed at Queen Mary's Military Hospital, Whalley, Lancs, to endeavour to establish the inference that any striking improvement in the condition of the patient might justly be attributed to the action of the serum. To this end, therefore, were chosen seriously wounded cases, with swinging temperatures, where every form of treatment had been tried without apparent success—cases which were considered to be at a standstill, or were actually going down hill. Neither septicæmia nor secondary hæmorrhage were held to be contra-indications, but cases presenting pocketing or sequestrum formation were excluded as far as possible, in order not to introduce disturbing factors.

The method of procedure evolved was as follows: If the man were, at the time, receiving spaced doses of A.T.S. there was no necessity to give a desensitizing dose, if not, this was always done, as before described. Fifty cubic centimetres N.H.S. was next inoculated, either subcutaneously or intramuscularly. The following day, if the man had passed a good night, 75 cubic centimetres or 100 cubic centimetres was given in the same way otherwise this second dose was delayed until the next day. Similarly the third dose, either 100 cubic centimetres or 150 cubic centimetres, at the discretion of the surgeon, was given the day following or the next day but one. Should the improvement in the patient's condition be sufficiently pronounced, there might not be any occasion for the inoculation of the third dose. On the other hand it might be necessary to give a fourth or a fifth dose, increasing each by 50 cubic centimetres as the surgeon might decide.

Every facility was offered and given, and it is with gratitude that I record the generous co-operation of the surgical staff, especially that of Captain J. A. Mackenzie, R.A.M.C., and Captain W. J. D. Bromley, R.A.M.C.

In cases uncomplicated by pocketing or sequestrum formation the results were consistently good, and, in the opinion of the surgeons concerned, who had had a very large experience in the treatment of chronic sepsis, were sufficiently traceable to the use of the serum to exclude the long arm of co-incidence. Time and again were noted the same stages of improve-

ment, both in the local and the general condition—not only did the wound take on a healthy look, but the patient himself began to sleep well, eat well, and altogether feel a different being. In certain instances, after treatment with serum had been started, the occurrence of pocketing and abscess formation necessitated operative interference, but even in these cases there was ample evidence of the effect of the serum treatment. Later it was decided to estimate the value of the serum when used prophylactically, and a case was chosen (*see* Pte. H., accompanying reports) where a previous operation had been followed by severe "flaring up" of the wound, where even the application of a soak preparatory to a further operation was followed by œdema of the part. On the preceding day, therefore, 50 cubic centimetres N.H.S. was given, and the operation resulted well—there was no flaring up, and the temperature never rose above 98° F., or the pulse above 96. Eears for the patient from the possible development of serum sickness were found to be groundless, as, in the few cases in which it did develop, the improvement was such that the attack was easily weathered.

Acomb and myself, while engaged in 1913 in the study of the complement content of various sera, attempted to induce increased complement production, since it was thought that an artificial method of increasing complement production might serve a useful purpose in the treatment of infective processes.

Assuming complement production to result from leucocytic activity, the inoculum chosen was an extract of leucocytes (sheep's). It was found that the serum complement content rose, more or less regularly, up to the twentieth day, to a considerable height, thereafter falling steadily until it almost reached the original standard, when estimations were discontinued.

Our attention was next drawn to the favourable experimental and clinical results obtained in infective processes with inoculations of leucocytic extract by Hiss and Zinsser (1908-09-10) [5], Alexander, Nauss and Williams (1911) [6], Manwaring (1912) [7], and several other observers. Discussing the mode of action of leucocytic extracts, Hiss and Zinsser first considered that complement was supplied to the infected animal, but they were not able to prove the presence of complement in their extracts. They therefore concluded that the beneficial effects were due to the action of digestive substances, not usually liberated from the leucocytes, of the nature of poison-neutralizing or destroying substances, which acted on the endotoxins and thus relieved the leucocytes of the animal from the effects of the poison and protected the higher cells, so that their functions were not destroyed. Manwaring held that, under certain conditions, the leucocytic endolysins might be given off into the surrounding medium in sufficient quantity to play an important extracellular rôle. Alexander, Nauss and Williams contended that the bactericidal power possessed by the endolysins was not sufficient to explain the results obtained. They showed also that, in the case of the inoculation of living leucocytes, the results were not due to phagocytosis. They noted that the inoculations were followed by polymorphonuclear leucocytosis.

Alexander (1913), in a written communication, informed me that he and Williams found that whenever there was a leucocytosis, the serum complement content showed a corresponding rise.

Nolf (1919) [8], in a paper on the intravenous injection of peptone in infectious diseases, illustrates the value of this form of therapy, not only in the treatment of typhoid fever, rheumatic fever, gonorrhœal rheumatism and coccal septicæmias, but also in the treatment of wounds, both where septicæmia has supervened, and also in those conditions where the sepsis is localized. He points out that the action of peptone is shared by a number of other inocula, such as non-specific sera (including N.H.S.), fresh serum from the patient himself, vaccines prepared from saprophytic organisms, distilled water and water to which has been added one or other antiseptic, such as chloramine, hypochlorite of soda, etc. Furthermore, he states that the reaction obtained by the subcutaneous or intramuscular method of inoculation is essentially the same as that obtained by the intravenous route, though attenuated in comparison. Here he refers especially to the shock which invariably accompanies the intravenous inoculation of every such substance, "in fact," as he says, "it is easier to produce shock than it is to avoid it." But he lays stress on the diminution of shock, so far as is possible, by the regulation of the dose, showing that the main object of the intravenous inoculation should be to produce the maximum therapeutic effect with the minimum amount of shock.

If he holds that the reaction is attenuated as regards the therapeutic effect obtained by the subcutaneous inoculation of, say, N.H.S., then one cannot agree with him, since the results obtained by this mode of procedure compare at least as favourably with those obtained by him following the intravenous inoculation of peptone, with the added advantage that no shock is produced.

Regarding the mode of action of peptone and, presumably, of other like inocula, he is, pending animal experiments which he proposes to undertake, unable to say more than to suggest that some action is exerted upon the leucocytes and plasma, whereby the defensive powers of the patient are stimulated. He also notes the same clinical phenomena following the intravenous injection of peptone as were described above as the result of the subcutaneous inoculation of N.H.S.; how that the patient feels better, becomes less excitable, and more inclined to sleep, the temperature is reduced, the prostration is lessened and disappears, and the appetite returns.

When one contemplates the results obtained by the exhibition of non-specific vaccines, one cannot help recalling the cruder, but probably identical, results obtained by the use of setons. It is easy to scoff at and hold in derision some of the ancient procedures adopted by our predecessors, but it should not be forgotten that in many cases they represent the survival of numerous trials and experiments, and that, underlying their use,

are to be found fundamental considerations, which we should not neglect merely because the old have been superseded by more modern methods.

It was on the hypothesis that the beneficial effects, experimentally and clinically obtained by the inoculation of leucocytic extracts, were essentially due to the introduction of protein that I was led to propose the use of N.H.S. as being a convenient and easily administered form of protein. Had leucocytic extracts been available at the time, their employment would have been suggested. I had hoped to increase the complement content of the patient, being persuaded that the condition of affairs in severe wound sepsis was due less to the absence of antibodies than to the absence, or relative absence, of complement.

Whether we agree with Gurd (1912) [9], who postulates a complementogen in the circulating blood, supporting the contention of Gengou (1901) [10], and more recently of Wollman (1913) [11], that complement does not exist as such in the plasma, or with Addis (1912) [12], and many others, including Watanabe (1919) [13], who hold that complement is actually present, we must, I think, agree that an adequate supply of complement, or complementogen, is of value to the individual. As Bosanquet and Eyre point out, "susceptibility to disease may depend on lack of sufficient complement. Some individuals may naturally be ill-supplied and pre-existing disease may exhaust the supply." How far the relative paucity of complement in the sera of children is bound up in their relatively low-resisting powers to infective processes is worth consideration, though, at the same time, one has frequently met with adults whose serum complement content was relatively low, who appeared to be in excellent health, and who did not seem to enjoy any less degree of health on that account. However, after all, the essential point may be not so much the actual normal serum complement content, as the capacity for complement or complementogen production when occasion demands and, bound up in this, the favourable response to a stimulus to such production.[1]

It is interesting to note that Woodhead (1918), in a verbal communication, informed me that the serum of guinea-pigs, which had received numerous inoculations of horse serum, extending over lengthy periods during the course of anti-serum standardization, had been found to possess a greatly increased complement content.

I therefore examined the sera of several of the cases at Whalley undergoing treatment with N.H.S., and although I expected, on a priori grounds, to find a steady increase in the complement content, I did not do so.

What I actually found was a relative stasis. True, the complement was raised in some instances, but the curve I had hoped to demonstrate was conspicuous by its absence. Incidentally, I was able to confirm the statement, in so far as the complement content in cases of hæmorrhage is

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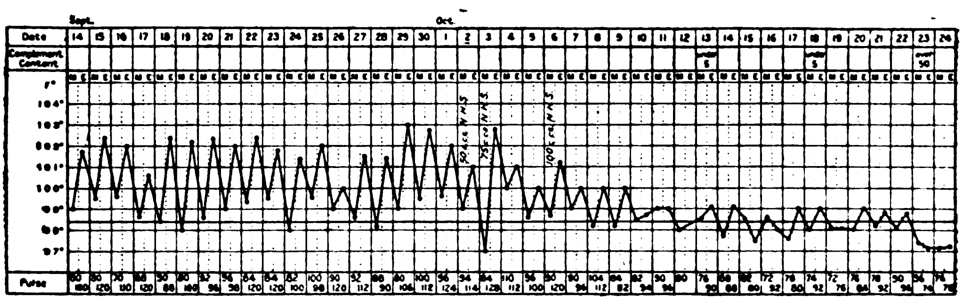
[1] See also Moro (1908) [14], who concludes that a capacity for the ready formation of complement is of prognostic value.

concerned, of Bosanquet and Eyre that "the formation of antibodies and complement is stimulated by the occurrence of hæmorrhage and fever," a phenomenon possibly accounting for the undoubted value in many cases of the ancient practice of blood-letting. Ill-health at the time precluded me from making the detailed estimations I had mapped out — viz., daily estimations, in selected cases, of total reds, hæmoglobin, colour index, total whites, differential count, complement content, clotting time of blood, the relative number and the types of organisms present, and the general clinical state. The results I obtained were rather in the nature of preliminary canters, but, at any rate, they were sufficiently numerous to induce me to come to the conclusion that if the complement or complementogen were increased, then the excess was as quickly used up, almost, as it was produced. If the improved condition of the patient be attributed to the increased production of complement or complementogen, then it is not difficult to assume that it is in reality utilized in the process, and for the present one is obliged to leave it at that.

Whatever, eventually, may be accepted as the underlying factor, or factors, responsible for the encouraging results following N.H.S. inoculation, there can, I think, be little question as to the value of this form of treatment in grave sepsis, and possibly in other conditions as well.

Appended are a few case-sheets illustrating the action of subcutaneous inoculation of N.H.S., chiefly in cases of grave sepsis.



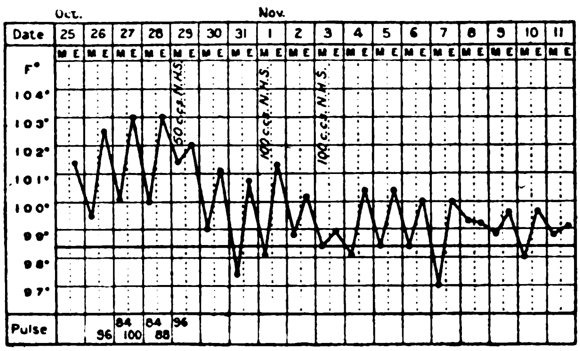
Pte. W.

September 1, 1918: Gunshot wound right elbow joint, severely lacerated and shattered; excised, fragments removed. Through and through wound of deltoid and acromium of right side; through and through wound face right side, malar bone smashed. 7th: Admitted Queen Mary's Military Hospital, Whalley. Wounds lying open, all extremely septic; elbow wound covered with grey membranous slough. Temperature up. 16th: Continuous flavine treatment adopted. Temperature swinging. 29th: Temperature, 103° F., still swinging; no improvement in wounds. October 2: Thoroughly septic condition; much emaciation; loss of sleep

and appetite; all wounds stationary; arm very swollen and œdematous; grey sloughs; "going down hill"; 50 cubic centimetres N.H.S. 3rd: 75 cubic centimetres N.H.S. 6th: 100 cubic centimetres N.H.S. 10th: Sloughs all disappeared; wounds granulating well; swelling going down. Great improvement in general condition; temperature normal; eating like a horse and sleeping well. 16th: Doing extremely well; arm looking well. 24th: Going very strong.

Pte. D., R.E.

September 10, 1918: Gunshot wound right leg with fracture of femur above the internal condyle, involving the joint; foreign body removed, wound drained; did well. October 1: Admitted Queen Mary's Military Hospital, Whalley. Condition pretty good; wound discharging. 6th: Wound started to discharge profusely, x-ray showed no bone necrosis, tube put in; temperature started to swing and continued swinging till the 14th when the temperature came down, but a profuse discharge persisted. 15th: Temperature again began to rise, temperature 101·2° F; anorexia. 16th: Temperature 102° F.; feeling very rotten. 17th: Temperature 101·8° F. 18th: 50 cubic centimetres N.H.S. 19th: Temperature down, returning to normal. 20th: 75 cubic centimetres N.H.S.; much less discharge, feeling much better; has a huge appetite. Progress maintained.



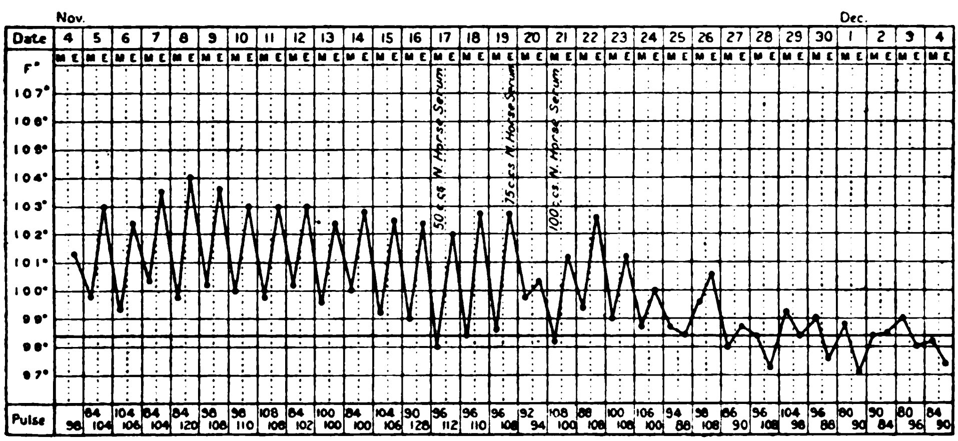
Pte. F.

September 28, 1918: Gunshot wound right upper arm, with compound fracture of humerus, a through and through wound; excision and removal of bone fragments at Casualty Clearing Station. October 10: Wounds dirty and septic. 12th: Admitted Queen Mary's Military Hospital, Whalley; wounds very septic; condition low and toxic, temperature 102° F.; condition continued with swinging temperature. 29th: 50 cubic centimetres N.H.S. 31st: Wound cleaning; appearance of red granulations; eats and sleeps well. November 1: 100 cubic centimetres N.H.S.; increasing red granulations; general condition good. 3rd: 100 cubic

centimetres N.H.S.; healthy granulations. 5th: Continued improvement, especially marked in general condition; eats and sleeps extremely well. 7th: Going strong; uninterrupted recovery.

Pte. D., W.R.

October 12, 1918: Gunshot wound left arm, head of radius and ulna badly shattered, joint opened, excised and bipped. 23rd: Admitted Queen Mary's Military Hospital, Whalley; condition poor; wound very septic and œdematous. 25th: Temperature 102·8°; much pain; wound sloughy and œdematous. 27th: Tube inserted; temperature swinging. 28th: Temperature, 103° F. 29th: Temperature, 101° F. November 1: Temperature, 103·6° F.; wound discharging foul pus. 2nd: Second tube inserted; condition getting much worse; temperature, 103° F.; pulse 100-120. 4th: Diarrhœa. 5th: 50 cubic centimetres N.H.S. 6th: Feeling better; temperature, 101·6° F.; pulse 96. 7th: 75 cubic centimetres N.H.S.; temperature, morning, 100° F., pulse 96; evening, 101° F., pulse 100. Much better; wounds very clean; pink granulations: sloughs all gone; little discharge. 9th: 100 cubic centimetres N.H.S.; going very strong. 11th: Feels himself again; wound quickly closing up; minute red granulations; temperature normal. 12th: "Cannot get enough to eat"; feeling very fit.



Pte. W., N.H.

October 23, 1918: Gunshot wounds severe both legs; badly spattered with shell fragments; no injury to bones, vessels or nerves; many small foreign bodies removed. November 4: Admitted Whalley; very septic condition; all wounds sloughing; colour of face yellow and unhealthy; swinging temperature. 17th: 50 cubic centimetres N.H.S. 19th: 75 cubic centimetres N.H.S. 21st: 100 cubic centimetres N.H.S. Rapid

improvement; wounds granulating well; appetite good; sleeps well; colour returning to face; feels very well; uninterrupted recovery.

Pte. G.

October 20, 1918: Gunshot wound right hip and groin; severe, extensive and communicating, involving gluteal vessels; also right wrist and left arm. 26th: Admitted Queen Mary's Military Hospital, Whalley; all wounds septic. 31st: Severe secondary hæmorrhage from gluteal vessels; wound laid open and vessels ligatured. November 1: Wounds septic; tissue very friable. 4th: Further severe secondary hæmorrhage; wound re-opened; tissue extremely friable; general oozing; no vessels tied; packed; skin blanched, lemon yellow tint; 50 cubic centimetres N.H.S., beneath fascia lata of thigh. 5th: More comfortable. 6th: Fair night; feels better this morning; eating well. 7th: 75 cubic centimetres N.H.S.; temperature down. 8th: Condition rapidly improving. 11th: Going on steadily; wounds cleaning up nicely; feeling very well; eating and sleeping well. 14th: Getting on by leaps and bounds; colour good; eyes bright; sleeps well; eats like a horse. 21st: Going strong.

Pte. B., R.E.K.

October 7, 1918: Gunshot wound right leg and left upper arm; lay out. Captured by Germans. 9th: Recaptured by British. Right leg amputated upper third of thigh for gas gangrene; wound of upper arm excised and F. B. removed. 14th: Secondary hæmorrhage of femoral artery; 900 cubic centimetres blood transfused. November 4: Admitted Queen Mary's Military Hospital, Whalley; condition extremely poor; emaciated; skin a dull yellow tinge; right thigh—flush amputation, the whole exposed, no attempt at granulations, surface smooth, light pink, no pocketing; no appetite; sleeps badly; mental state depressed. 8th: Slight delirium, with rigor. 9th: No change in condition, local or general; short streptococci recovered from blood; complement content 15; 50 cubic centimetres N.H.S. 11th; Commencing improvement in stump; wound looking a little healthier; 100 cubic centimetres N.H.S. 12th: Complement content 30. 13th: Slight general improvement, feeling a little better; complement content 20; 100 cubic centimetres N.H.S. 14th: Complement content 15. 15th: Granulations spreading; appetite improving; sleeps fairly well; complement content 5; 125 cubic centimetres N.H.S. 16th: Complement content 5. 17th: Steady improvement; colour of face returning, but mental condition low, firmly believes his lungs are hopelessly diseased; complement content 20; 150 cubic centimetres N.H.S. 18th: Wound closing up, granulating round the edges. 19th: Complement content 5; 150 cubic centimetres N.H.S. 20th: Complement content 20. 22nd: Much better; wound going strong; eating and sleeping well. 24th: Still improving; putting on weight. 26th: A great deal better; colour much improved, face filling out; enjoys his

food; strong healthy granulations on stump. Convalescence was delayed by an infection of the seat of inoculation in the outer side of the left thigh.

Pte. McA.

September 27, 1918: Gunshot wound right lumbar region; bullet removed inner side of right thigh; wound not touched; gunshot wound through and through left forearm, with fracture of radius; track cleaned and loose bone removed. October 3: Admitted Queen Mary's Military Hospital, Whalley; had been bleeding for two to three days from arm wound; very ill; condition low; much blanched; no appetite. 6th: Still oozing blood, very blanched. 12th: Very ill and drowsy; wounds dressed only. 14th: Complement content 80. 15th: 50 cubic centimetres N.H.S. 16th: Very comfortable; slept well. 17th: Feeling better; appetite improved; sleeps well. 18th: Much better; temperature steadily down; eating well. 19th: Condition splendid; uninterrupted recovery; complement content on October 25, 5; on October 26, 10.

Pte. J.

September 19, 1918: Gunshot wound upper third right calf with fracture of fibula. 28th: Admitted Queen Mary's Military Hospital, Whalley; wound septic. October 3: Secondary hæmorrhage of posterior tibial artery. 10th: Temperature, 103·6° F. 11th: Operation wound opened and packed with bipp for further secondary hæmorrhage; 50 cubic centimetres N.H.S. 12th: Condition low; much blanching and emaciation; appetite poor; sleeps badly; 50 cubic centimetres N.H.S. 13th: 60 cubic centimetres N.H.S. 14th: Very restless; no sleep; much pain in wound; no appetite; temperature, 103·8° F. 17th: Packing removed; condition of wound good. 18th: General condition improved; more comfortable, sleep and appetite better. 19th: Going strong; complement content 40; uninterrupted recovery.

Pte. B. M.

October 23, 1918: Gunshot wound left humerus; compound fracture. Gunshot wound through and through left upper arm, and laceration of left forearm. 31st: Admitted Queen Mary's Military Hospital, Whalley; wounds very septic; much sinus and sequestrum formation: wounds discharging freely. November 4: General condition poor; emaciated; considerable suppuration; grey sloughs; no red granulations; sleep and appetite poor; 50 cubic centimetres N.H.S. 5th: A fair day; arm painful. 6th: Much pocketing; operation suggested; much opening up done; pus found tracking up; 50 cubic centimetres N.H.S. 7th: Looks ill; a fair night. 9th: 100 cubic centimetres N.H.S.; sleeps much better; appetite very good. 21st: Going strong; good colour; fatter; eats and sleeps well; uninterrupted recovery.

Rfn. P.

August 24, 1918: Gunshot wound, abdomen; shrapnel entered left flank between costal margin and anterior superior spine, producing laceration of anterior abdominal wall half way between umbilicus and pubis; some bruising of small gut. 25th: Laparotomy; foreign body removed; abdomen closed in layers; no drainage. September 5: Admitted Queen Mary's Military Hospital, Whalley; condition fair; some general wasting; no abdominal distension; bowels acting well; wound in back almost healed; 12th: During the past week slight elevation of temperature; slight suppuration near abdominal cicatrix, some tenderness and tympanites; no pain, vomiting or tenderness during the day; after a turpentine enema night sister observed patient in discomfort, on removing bandages found protrusion of small intestine from abdominal wound, which had sprung open. 13th: 3 a.m., operation, partial obstruction of bowel by adhesion to left side of wound reduced; bowel irrigated and replaced; wound sutured and drained; general condition grave. 14th: Bowel contents started to flow from posterior wound. 15th: Discharge from abdominal wound changed two-hourly; natural movement of bowels. 18th: Abdominal wound septic; tube removed, wound now gaping, bowel plainly seen; extreme general wasting; condition precarious. October 18: Small piece of gauze found projecting from posterior wound and removed (apparently present since laparotomy of August 25). 24th: Abdominal wound starting to skin over, but extremely unhealthy looking. 28th: General condition very poor; excessive wasting; sleeplessness, loss of appetite, mental depression; 1 cubic centimetre N.H.S.; no local reaction, at end of two hours 50 cubic centimetres N.H.S. beneath fascia lata. 29th: Complement content 25. 30th: 50 cubic centimetres N.H.S.; feels brighter. November 1: 50 cubic centimetres N.H.S., more cheerful. 3rd: Sleeps well and soundly, no wild dreaming; headache gone; has good appetite; looking much better, eyes brighter. 4th: 50 cubic centimetres N.H.S.; taking more interest in life. 6th: 50 cubic centimetres N.H.S., looking heaps better, feels lively, wants to get up; eating ravenously. 7th: Complement content, 5. 9th: 50 cubic centimetres N.H.S., going very strong; 11th: Complement content, 5. 13th: improvement steadily continuing.

Serjt. F.

August 31, 1918: Gunshot wound through and through right chest wall; laceration of pectoral muscles; fracture upper edge of 5th rib in nipple line; muscles excised; wound bipped and sutured. September 3: Considerable cough, some emphysema. 4th: Admitted Queen Mary's Military Hospital, Whalley, following forced evacuation; small wound above right nipple; sutured wound across lower border of pectorals; some dulness and diminished breath sounds right base, no adventitious sound; slight hæmoptysis. 9th: Temperature 102·2° F., respiration 32, pulse 100;

very troublesome cough; breathing distressed; rusty expectoration. 10th: Temperature 102·8° F.; very restless—morphia; condition remained stationary, with swinging temperature; very troublesome cough, with much expectoration; condition poor; most restless. October 9: 50 cubic centimetres N.H.S. 11th: 50 cubic centimetres N.H.S. 13th: Temperature normal and remained so. 19th: Cough now troublesome at night only. November 4: Expectoration decreasing in amount, less purulent; general condition remarkably improved. Sleeps and eats well and is looking heaps better, having lost cyanosis completely. 21st: Has been up and about for a week, is getting fat.

Pte. B.

September 26, 1918: Gunshot wound (gas shell, was wearing mask at time), abrasion right forearm; cleaned and drained; wound outer-side right thigh, excised and sutured; wound inner side right thigh, incised; foreign body not removed; through and through wound right leg, excised; posterior tibial vessels found divided—ligatured; comminuted oblique fracture of tibia, loose fragments removed; irrigated; Thomas' splint. 28th: Redressed at Casualty Clearing Station. 29th: Sent down by barge; temperature 100° F., to 100·2° F. October 1: Wound of right leg incised and opened; thigh excised and opened and wounds cleaned at General Hospital. 3rd: Admitted Queen Mary's Military Hospital, Whalley; all wounds dirty. 16th: Since admission temperature swinging from 97° to 100° F.; wounds septic. 18th: Temperature 103·8° F. 22nd: Temperature 103·8°. 28th: Wounds continue septic, in spite of constant treatment with flavine, complement content 15; 50 cubic centimetres N.H.S. prophylactic to op. following morning; collapsed during night; condition grave. 29th: Right leg amputated; condition very low, pulseless; passed a fair day. 30th: Complement content 20—75 cubic centimetres N.H.S. 31st: Much better: eating and sleeping well, complement content 5. November 1: No further dose given as temperature steadily fell and wounds improved; complement content 5. 5th: Going strong. 3rd to 8th: Daily estimations of complement content, each 5.

Pte. H.

April 20, 1918: Gunshot wound *left* leg, simple wound; gas gangrene set in and leg was amputated. 29th: 15 cubic centimetres *A* and 20 cubic centimetres *B. welchii* serum given in France. June 2: Generalized sepsis with local areas of infection—right knee-joint, left buttock and right pectoral region. 4th: Admitted Queen Mary's Military Hospital, Whalley, forced evacuation—air-raids; condition very low; right knee stiff and swollen; right ankle swollen; large wounds in left perineal region, left loin and in each side of the chest; acute diarrhœa. Prognosis very grave. 18th: 20 cubic centimetres anti-streptococcic serum, swinging temperature to 103° F. 21st: Temperature normal for two days, then started swinging.

28th : 20 cubic centimetres A.S.S., no result ; tremendous pain and much swelling, with brawny hardness in *right* ankle, leg and hip. July 26th : Amputation of leg at thigh, hip not drained ; temperature still kept up. August 13 : Hip opened ; extra-articular abscess drained. 14th : 40 cubic centimetres A.S.S. 15th : Temperature rose slightly then fell to normal. Condition improved daily until September 1, when a piece of dead bone was removed from *left* stump, the wound flared up very badly. Temperature started to swing and kept up for five days then settled down. Went on quite well till the 2nd, when it was decided to reamputate left leg. A preparatory soak was applied, this was followed by œdema of the stump. Temperature 100° F., pulse 124. Operation postponed. 13th : *50 cubic centimetres N.H.S. given prophylactically.* 14th : Reamputation performed, a very good result—no flaring at all; temperature never rose above 98° F., pulse 96. Note also interesting result following inoculation of 40 cubic centimetres A.S.S. on August 14.

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THE PREVENTION AND DESTRUCTION OF RATS.

By Serjeant-Major E. B. DEWBERRY,
Royal Army Medical Corps.

"Rats!
They fought the dogs and killed the cats,
And bit the babies in their cradles,
And ate the cheese out of the vats,
And licked the soup from the cook's own ladles,
Split open the kegs of salted sprats,
Made nests inside men's Sunday hats,
And even spoiled the women's chats,
By drowning their speaking
With shrieking and squeaking
In fifty different sharps and flats."
(Browning's "Pied Piper.")

It is well known that rats play an important rôle in the dissemination of the germs of disease, such as plague (spread to man by fleas which infest these rodents). They are also responsible for transmitting and perpetuating trichinosis (*Trichina spiralis*), certain tape worms, and other parasites. With regard to plague; in a memorandum by the Local Government Board, it is stated that "Plague for administrative purposes may be regarded as a disease of rats which incidentally and occasionally attacks man." Recent researches have also proved that the rat is the carrier of two protozoal parasites causing the diseases known as spirochætosis icterohæmorrhagica, and sokodu, or rat-bite fever, and both these infections have been established by Japanese observers. The rat has also been found to be the natural reservoir of the spirochæte of infectious jaundice, not only in Japan, Belgium and France, but also in America, Algeria and Tunis. The flea and louse apparently play an important part in the spread of the infection amongst rats.

Outbreaks of food poisoning have from time to time been attributed to the contamination of food by the excreta of these rodents and the germs carried on their bodies, consequently the presence of these vermin in barracks, camps and hospitals must be regarded as a grave menace to the health of the troops.

Rats, in addition to being carriers of disease, devour and destroy enormous quantities of food yearly, and are the enemies of the hen-roost, pigeon house and rabbit warren, etc. The gradual waste and consequent financial loss caused by the depredations of these vermin, is not easily detected, but is continuous, and soon amounts to a considerable sum of money. It has been estimated that one rat causes, by the destruction of food and materials, on an average, damage to the extent of a farthing a day (roughly 7s. 6d. per year), amounting to a total loss through the agency of

rats of £15,000,000 per annum in Great Britain and Ireland; but this enormous sum probably does not include the actual value of the food spoiled, or the damage done by this pest on board ship. It must also be remembered that the destruction to property caused by these vermin burrowing under foundations, gnawing their way through floors, partitions, gas and water pipes, means considerable expense to firms and public bodies, on repairs.

Although the problem of rat extermination is a difficult one, owing chiefly to the migratory habits of these rodents, it is necessary, both from an economical as well as from a sanitary and medical point of view, that some stringent measures be taken to combat the nuisance, viz., to round up and kill these vermin, which during the last five years have increased at an alarming rate, owing to the war, lack of labour, and neglect of ordinary precautionary measures.

On the London docks rats do incalculable damage. The rat catchers under the port sanitary authority killed over a million during last year. In the rural districts farmers also suffer from the depredations of these rodents as they consume and destroy root crops, fruit, vegetables, steal the eggs and young of poultry, and have even been known to suck the milk from the teats of a cow in order to obtain food. During the late war large numbers of rats were present in the British trenches where they were hunted by the troops with dogs and ferrets, and without doubt they were a source of annoyance and did considerable damage. It is not at all improbable that they were in many instances responsible for the dissemination of jaundice.

In the French Army it is said that large numbers of dogs were dispatched to the front to deal with the pest in the trenches, and one army corps, in a fortnight, disposed of 8,000 rats. A small reward was offered for each dead rat and the sport of catching them proved very popular amongst the men.

No doubt many readers of this article remember seeing rats at night scampering along the back streets in some of the towns and villages in France. Being disturbed during their evening meal off the heaps of garbage (dumped on the sides of the streets ready for removal next morning), the rats quickly disappeared up the nearest rain-water pipe.

The rat has long been the enemy of man, even from the time of the Egyptians, who regarded their cats as sacred animals, and specially trained them in the art of hunting the vermin.

The two species of rat met with in Great Britain are the "Black Rat," (*Rattus rattus*, commonly called the ship rat or house rat), and the "Brown Rat" (*Rattus norvegicus*, known as the common rat, water rat, barn rat or sewer rat). The latter is the one most frequently seen in this country.

The black rat has been described by the ancient Greeks as being associated with their outbreaks of plague, and it is recorded that rats were prevalent in enormous numbers in the middle ages, causing outbreaks of plague and also destroying property and food.

The black rat is common in India, where the climate is suitable for

its well-being, and it breeds prolifically. It is the chief species which infests our ships, where cases of plague sometimes occur ; and consequently it is conveyed by commerce to all parts of the world. The black rat is sometimes called the "old English rat," and the species is still to be seen in warehouses on the docks in London and also at Yarmouth.

Dr. Hanna, Assistant Medical Officer of Health, Liverpool, in a recent article, said: "The black rat is, in the main, the plague-carrying rat, and an estimate of the different species identified amongst those caught in the city and port of Liverpool reveals the fact that, of a total catch during 1917 and 1918 of 34,189 rats, the brown rats exceeded the black rats in city warehouses, sewers and other places in the city in the proportion of approximately nine to one. On the dock quays the numbers are almost equal, while on the ships the black rats exceed the brown rats in the proportion of 139 to 1. It must be mentioned, however, that the proportion of black to brown rats in the dock area varies according to the district. In some areas, where foreign-going steamers have permanent berths, the black rat very largely predominates; in the port area, on ships and docks as a whole, the black rats exceed the brown in the proportion of ten to one."

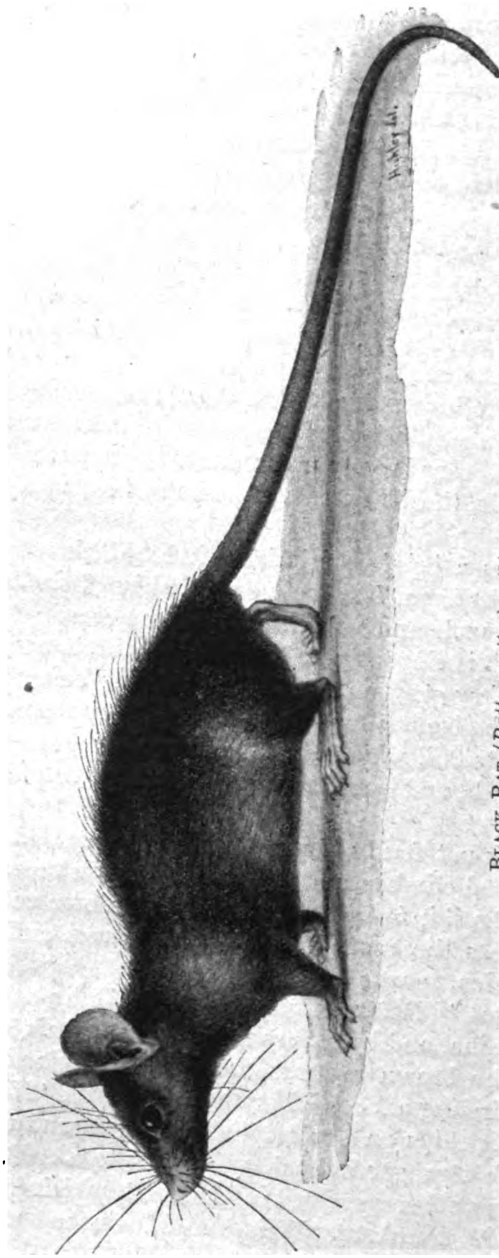
The following is a brief description of the black rat (*Rattus rattus*): it averages in weight from 7 to 8 ounces, is about 7 inches in length, and has a sharp long muzzle and comparatively large ears.

The body, which is elegantly and slenderly built, is covered with greyish black soft fur (smokey grey on the belly), the fur being often intermixed with bristles, which give it a harsh appearance. The ears, feet and tail are black in colour. Its tail, which is long and scaley, measures from eight to nine inches in length, and is a little longer than the combined length of the head and body.

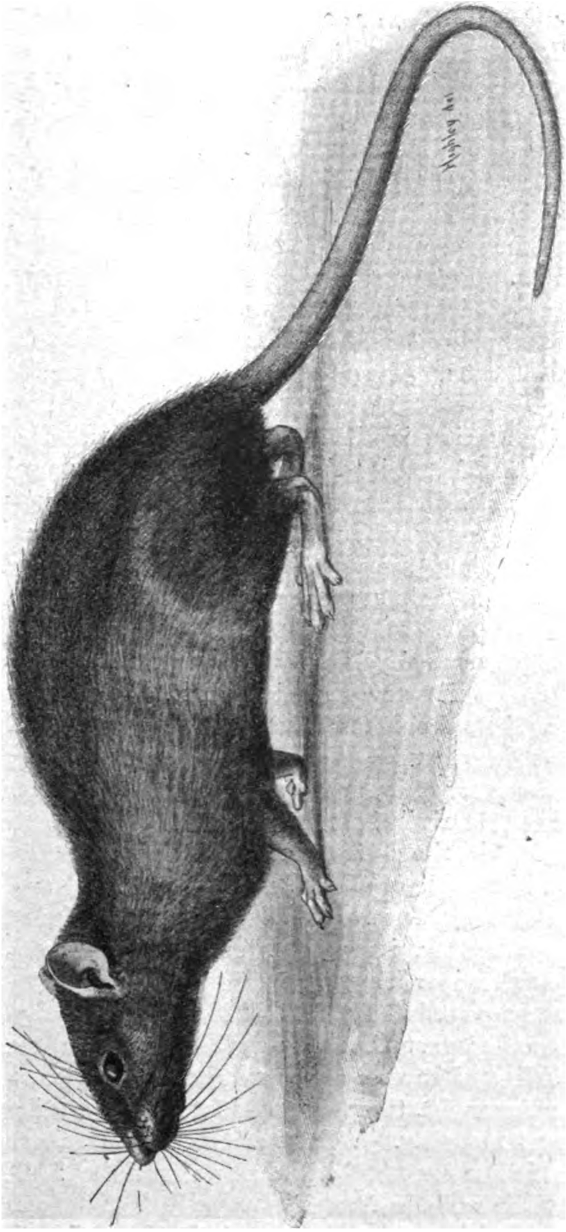
The black rat is not fond of burrowing, and very seldom enters water; it is, however, a good climber, and on board ship it is therefore able to make its escape (when the ship is in port) by climbing down the cables on to the docks. It frequents the roofs and walls of houses and huts, but is not often found in drains, sewers or cellars.

"The brown rat" (*Rattus norvegicus*) is said by some to have come originally from China, and by others from Central Asia or India. Boelter says: "In 1731 the brown rat was brought to England in ships coming from India, and, finding a foothold in the land of the 'Mistress of the Sea,' it proceeded on her ships on a triumphal journey round the world." Being a large and much stronger animal, and suited to a cooler climate, it soon waged war on the weaker species, the black rat, which it fought and killed, greatly reducing its numbers. It is the brown rat with which we are chiefly interested at the present time.

It weighs nominally about 9 to 17 ounces, and measures from 8 to 9 inches in length (head and body). The body is inclined to be heavy and rather clumsily built; it is covered with softish fur (softer than that of the black



BLACK RAT (*Rattus rattus*). (½ natural size.)



BROWN RAT (*Rattus norvegicus*). (½ natural size.)

rat), which is of a greyish to reddish brown colour, yellowish grey underneath. The head of the brown rat is powerfully built, with blunt jaws, the ears being rather small and covered with short, thick hairs.

The tail is stout, and somewhat shorter than the combined length of the head and body. Its ears, feet and tail are flesh-coloured.

The females of both the above species breed very prolifically, and commence at an early age; consequently, if well supplied with food, the numbers of rats increase at an enormous rate.

The brown rat, which is more prolific than the black rat, produces several litters a year, averaging from 6 to 9 young, but sometimes as many as 22. It is said that one pair of rats will within nine months give rise to a progeny of 880 rats. To show how prolifically these rodents breed: in 1901, on an estate in Chichester which was badly infested with rats, 31,981 were killed by traps, poisons and ferrets, and during the threshing season 5,000 more were destroyed. Even then the property was not free from these vermin.

The period of gestation is about twenty-one days. De L'Isle, experimenting with *R. rattus*, found it to be sexually mature when less than three months old; and Buckland records that a female *R. norvegicus* in capivity bore a litter of eleven young when only eight weeks old, so that she must have been impregnated at the age of five weeks. The young are born blind, and are weak and helpless, their eyes opening about the fourteenth day.

The brown rat (*R. norvegicus*) is a very strong, voracious, agile, cunning and fierce animal, especially when driven into a tight corner, and is a fairly good climber. It frequents barns, stables, basements of buildings, drains, sewers, slaughter-houses, grain stores and wheat-stacks, etc. This rodent is a great lover of water, and can swim some distance. It burrows into the banks of canals, rivers, ponds and water-courses, where it abounds in large numbers, and in the burrow it makes its nest.

The brown rat is capable of adapting itself to almost any surroundings, and frequently infests coal mines. It will gnaw through almost any obstacles, such as lead pipes, leather, ivory, etc., and in this way keeps its ever-growing incisors at a proper length.

Boelter relates an anecdote by Buckland on the ferocity of the brown rat. "A London rat-catcher shut up together in a cage the result of his day's work, consisting of several dozen rats of both species, and put them away carefully for the night, their intended fate being to afford sport for his employer's dog next morning. What was his astonishment, when he came to fetch them, to find none but brown rats remaining! These cannibals had devoured all their sable brethren."

The migratory habits of rats are well known. In the spring they depart into the open fields, where they burrow and pass the summer. In the early winter they re-establish themselves in buildings, lay up in their holes during the day, and go forth in search of food as soon as it gets dusk.

This migratory habit makes extermination of the pest a difficult matter. At times when food is short, or when in search of change of food, they migrate in vast numbers during the night; this also frequently happens when disease has attacked some of their numbers. When persistently hunted, these rodents forsake their abode, and migrate to a more favourable situation. It is said that in towns on the seacoast (such as Yarmouth) rats become attracted by the fish offal, and are present in considerable numbers. In October, however, owing to the shortage of food, they migrate inland. These moving hordes of rats have been frequently seen and recorded. Pallas relates that "in the autumn of 1772 they arrived from the East at Astrakhan, South-eastern Russia, in such great numbers and so suddenly that nothing could be done to oppose them. They crossed the Volga in immense troops. The cause of this general migration was attributed to an earthquake, but, since similar movements of the same species often occur without earthquakes, it is possible that only the food supply of the animals was involved in the migration."—Roseneau. In towns, rats do not migrate so readily, but remain near their habitations, unless disturbed by being hunted.

When driven by hunger these vermin become exceedingly ferocious and will fight, kill, and afterwards devour the dead bodies of their comrades, those injured and unable to defend themselves sharing the same fate. When hard pressed, rats do not hesitate to attack man. They will eat almost any kind of food, such as grain and seeds, flour, vegetables, bulbs, garbage, offal, dead bodies of animals. They kill game, fowls, ducks and young rabbits, and suck the eggs of birds and fowls, and frequent bakeries, slaughter-houses, knackers' yards and such like places. This great variety of food no doubt enables rats to live in any environment. Shipley says, "The rats which infest the London Zoological Gardens are said to swim nightly the canal in Regent's Park." Presumably they visit the Gardens to take a share in the food supplied to the animals, and are killed in large numbers by the employees. When worried by a dog, rats will display considerable cunning, and to avoid the dog they will dive into a stream (if one is close at hand) and remain under the water for some time coming to the surface some distance away.

Before discussing the practical methods for the destruction of rats, it may not be out of place to quote a recent leading article from the *Times* newspaper, on the introduction of the Bill on the destruction of rats and mice.

"The introduction by Sir A. Griffith Boscawen of the Bill for the Destruction of Rats and Mice, prepared by the Ministry of Agriculture and Fisheries, was greeted in the House of Commons with ironical cheers. Whatever may be the precise political significance of this levity—and incoherent majority tends to breed political rats—we trust that in its further stages the Bill will receive the prompt and serious treatment it deserves. It deals with an urgent need. Rats and mice make huge

inroads on our food supply. Sir James Crichton Browne estimated that, in England alone, rats destroyed food to the value of £15,000,000 in 1908. Since then the value of food has increased manyfold, and there is good reason to fear that vermin have multiplied. They damage property in many ways. They block, divert, or destroy drains and water-pipes. They have been known to cause fires by damaging the insulation of electric wires. They gnaw leather, wood and textiles of all kinds, sometimes to make their runs, sometimes to line their nests. They are a direct menace to health. The most notable instance is their relation to plague. The rats of plague-stricken countries are permanent reservoirs of the disease, and rat-fleas carry the microbes from rat to rat, or from rats to human beings. They are a link in the propagation of many other diseases, and they are intermediate hosts of parasites that affect man and his domestic animals. They are cunning, hardy, and prolific, and it is impossible to reduce their numbers effectively by isolated effort. They migrate from house to house, from farm to farm, from country to country. If an energetic assault be made on them in one place, they flow into the vacuum from surrounding areas. The provisions of the Bill are simple, and the machinery provided should be effective. In the first place, the alien immigrant is to be kept from landing. The Bill is to apply to a vessel as if the vessel were the land, and the master of the vessel is to be deemed to be the occupier. The port sanitary authority has the duty of seeing that ship rats are destroyed. This step, in combination with the usual step of securing that persons affected by plague are quarantined, should effectively safeguard the country from a by no means impossible calamity. Every occupier of 'land'—and 'land' is defined as including any buildings or erections on it, or any sewers, drains, or culverts in it, has the statutory duty, under penalties, of taking reasonable and practicable steps from time to time for the destruction of rats and mice. The Common Council of the City of London, the Borough Councils of London, and the county and borough councils and port sanitary authorities are provided with the powers necessary to see that occupiers comply with the regulations. The Ministry of Agriculture and Fisheries in England, the Board of Agriculture in Scotland, and the Local Government Board in Ireland are enabled to enforce the provisions of the Act if, in their opinion, the local authorities fail in their duty. No suggestions as to the methods of destruction are made. This is wise, as the methods must vary with the special conditions and be the subject of expert inquiry."

Boelter says, "The first practical attempt at destroying rats in the public interest, in order to minimize the damage done by them to private and public property, seems to have been made in England. About the year 1740 ordinances were made by numerous parishes directing the churchwardens to pay one penny—in some cases twopence—for every dead rat brought to them. But soon the hopelessness of the task becomes apparent and the ordinances fall into disuse.

Towards the middle of the eighteenth century an English colony, realizing that anything short of concerted action must fail against the enormous fecundity of the brown rat, endeavoured to deal with the rat problem by means of a law. The original Act of 1745 does not appear to have been preserved either at the Colonial Office or at the British Museum, but there is a record of an Act passed in 1748 which contains the law of 1745. Quite recently (July, 1908) a third Rat Act was passed."

Recent orders on the subject are the Rats Order, 1918; the Local Authorities (food control) Order (5), 1918; the order amending the Rats Order, 1918, dated March 26, 1919; and the Local Authorities (food control) Order (1) 1919. The enforcement of these orders is the duty of the appointed official. The War Office appointed officers for the purpose of the Rats Order, as the question of rat extermination is not only of the utmost importance to the civil population but also to the military authorities, and it is hoped, by the combined efforts of the civil and military, to ensure a successful campaign against this pest.

In a presidential address, delivered last year before the Royal Society of New South Wales, Dr. J. Burton Cleland pointed out that a town that lets its rats multiply is exposed to a menace that may lead to enormous financial losses and possibly a heavy death roll. Rats lead a communal life in direct contact with each other, and thus the passage of any pathogenic organism is facilitated, while in the passage the pathogenicity of the less lethal forms is probably increased.

In a campaign against rats, it is essential that the greatest energy and zeal should be displayed by all concerned in carrying out the necessary methods of destruction; working in a half-hearted manner is practically useless. In the service, the troops should be instructed in the art of laying poisons, setting traps, ferreting, etc.; as it is only by the co-operation of all ranks that the anti-rat measures can be efficiently carried out, and the best results attained. Where possible a professional rat-catcher could be employed, failing this a reliable "volunteer" could easily be instructed in the art of rat-catching. It has been suggested that the cinematograph might be used as a teaching medium. Films depicting the life history, habits, and the depredations caused by rats, could then be shown to the troops, and so stimulate their interest, as there is nothing "like seeing a thing, to believe it."

Preventive Measures.

The protection of all food supplies, the careful removal of waste food so as to avoid spillage, the destruction of refuse, the rat-proofing of buildings, such as hospitals, huts, etc., in barracks and camps, the protection of drains and sewers, and the fumigation of ships, are some of the preventive measures which must be adopted.

Protection of Food.—Buildings, especially those where forage is stored, and dining rooms, cook-houses, meat stores, canteens, institutes, bakeries,

etc., should be rendered rat-proof. Where large quantities of food are permanently stored, a rat-proof fence should be erected and all rats inside this exterminated. The fence can be made of half inch mesh wire netting, the lower edge being buried eighteen inches under the ground, and along the top a piece of tin is fastened sloping downwards towards the exterior. All food stored in cook-houses, messes, canteens, regimental institutes, etc., should be protected by means of wire netting, or kept in wire gauze safes. In large stores the provision of wooden grids raised about one foot off the floor have been found effective. Stacks of wheat, etc., should be raised about three feet off the ground on platforms supported by piles; the latter should be furnished with metal rat guards of large diameter, in order to ensure that the rats do not climb up the piles and infest the stack. In stables, concrete or metal forage bins should be provided. The angles of all wooden receptacles and the lower parts of doors should, where possible, be covered with tin sheeting.

Removal and Destruction of Refuse.—All refuse should be temporarily placed in rat-proof receptacles, such as metal bins with close fitting lids, and the bins should never be allowed to overflow. Refuse so stored should be promptly removed and destroyed. The formation of heaps of rubbish is a dangerous practice as these afford good shelter and food for rats. Such accumulations may in time become the principal breeding places of rats. Burrows from which the vermin have been driven should be filled with concrete; a mixture of cement, sand, and broken glass or crockery; or of broken glass or tar, in order to prevent the rats re-establishing themselves in the holes.

Protection of Buildings and Drains.—New buildings should be rendered rat-proof by the liberal use of Portland cement concrete, in foundations and cellar floors, and all doors, windows, ventilators and drains adequately protected. Existing buildings such as old barracks, huts, hospitals, grain stores, forage stores, warehouses and stables, etc., should be repaired if necessary, and afforded similar protection against rats. Openings into drains and sewers should be efficiently sealed, and any repairs to the pipes receive prompt attention. The inlets and outlets of ventilating pipes should be protected by means of wire cones. In the case of infectious disease hospitals, particular care should be taken that all buildings are rendered rat-proof, and that there is no possibility of rats gaining access to any receptacles in the hospitals, or to the drains.

In "Dangers to Health," by Doctor Teale, instances are given illustrating the grave dangers which may result from rats getting into drains. "To have rats appear in a kitchen or cellar the presumption is that they come out of a drain. A hole in a drain which permits the escape of a rat will allow the sewer gas to be drawn into a house, *pleno flumine*. When a waste pipe or a sink joins a drain under a kitchen floor instead of discharging into a gulley outside, this is what usually happens. The sink pipe religiously trapped passes neatly through the kitchen floor. Beneath the floor and out

of sight it passes into an open wide-mouthed drain-pipe, four or six inches in diameter, with neither cement nor luting to bar the escape of rats or sewer gas. This piece of scamping, being out of sight, is exceedingly common, and is often overlooked by inspectors who satisfy themselves with a peep at the syphon trap, and take no account of the gaping pipe concealed beneath the flag, ready to let the rat and the gas out of the drain. Even if cement were used it would be no sufficient protection against the rats making their way into the house. In two other ways rats do mischief—one, by eating through the lead pipes to reach water or fat; the other, by making runs under drain-pipes and letting down and opening the joints. Open drain joints concealed under a cellar floor can often be detected in the following way: shut all windows and outer doors; open all doors between the cellar and the fires in the house; then hold a lighted taper opposite any crevices or fissures." It has been estimated that seventy-five per cent. of the cases of rat invasion in houses in towns are due to defective drains.

Dr. Hanna says: "Rats frequently gain an entrance into warehouses, where cotton, grain, etc., are stored, from the sewer by the drain in the basement. Salvage companies require a drain in the basement of warehouses so that water can escape in case of fire salvage operations. The water seal is frequently dry and the drain untrapped. Under such conditions rats gain an entrance into warehouses for food and shelter: they may return to the drain and sewer for water, but frequently there is water in the top floor of the warehouse and the rats may remain in the building for a time, and may carry infection from the warehouse to the drains, and *vice versa*. An exceptionally high tide may drive all the rats up the drains into the warehouse. It is, therefore, important to examine the basement drains in a warehouse before rat exterminating operations are carried out."

Methods of Destruction.

Measures taken for the destruction of rats should be carried out simultaneously over a wide area and reliance should not be placed on any one method. Extermination is practically impossible as rats readily migrate, and the most that can be hoped from measures against rats is some reduction in their numbers. It should be recognized that the existence of these vermin is strictly dependent upon the food they are able to procure, and that they will not remain or increase in places where such cannot easily be obtained.

Natural Enemies.—Large numbers of rats may be killed by men, dogs, or cats. The fullest protection should be accorded to the rat's natural enemies, such as owls, buzzards, kestrels, sparrow-hawks, rooks, crows, gulls, herons, weasels, stoats and foxes. Many of the natural enemies of these vermin are killed indiscriminately as they are disliked. The owl, for instance, which lives almost entirely on living prey, owing to the weird hooting noises he creates at night is often regarded as a bird of ill-omen,

and shot on sight, whereas he is of the greatest service in the destruction of rats. As many as twenty freshly killed rats have been found in a single owl's nest. In fact all the above creatures are most valuable allies, and destroy numbers of these vermin. The mongoose is also a useful animal in this respect, but there is now some difficulty in getting it exported from India.

The methods adopted for the destruction of rats are:—

(*a*) Poisoning.

(*b*) Trapping.

(*c*) Hunting with dogs and ferrets.

(*a*) *Poisoning.*

There is a large trade nowadays in the sale of rat poisons, some of which are very effective in killing rats, while others are more or less useless. The active poisoning agent in most of these preparations is usually one of the following: Arsenic, phosphorus, strychnine, squills, barium carbonate, and plaster of Paris.

When using rat poisons, the greatest precautions must be taken to avoid accidents, and it is desirable that notice be given to all concerned when any poison is being laid down. All domestic animals must be safeguarded, and the unconsumed portion of the poisonous bait removed and destroyed, in order to prevent them obtaining access to it; besides there is also a possible risk of prosecution under the Acts relating to the use of poisoned grain, meal and meat. These Acts are: "The Poisoned Grain Prohibition Act of 1863; The Poisoned Fish Prohibition Act of 1864, and the Protection of Animals Act, 1911." The dead bodies of all rats killed by any of the above methods must either be buried or burned, they should never be offered for sale, as there is a danger attached to the handling of sick or dead rats. Poisoning should be carried out over a large area once or twice during the year, i.e., in the spring and in the late autumn. To ensure success the following preliminary measures should be adopted: As large an area as possible should be covered at one bait setting, and a careful survey made beforehand in order to have a sufficient supply of bait to lay down over the whole area simultaneously. One hour should be sufficient time for bait laying. The next day another survey should be made and all the remaining baits collected and counted. It is no good laying down poison in the same area more than twice a year, and it should be followed up by trapping. Sometimes it is advantageous to bait without the actual poison for two or three nights, in order to entice the rats. In this case the number of baits laid down should be counted, and also those remaining the next morning, so as to be able to ascertain the actual amount of bait required, and where to lay the poison. If it is found necessary to repeat the poisoning, an interval of at least ten days should be allowed to elapse. Poisonous baits should be laid well within the burrows, as there is always

the chance of a rat carrying one off, and depositing it in an exposed position, to be afterwards devoured, perhaps, by a domestic animal.

The amount laid in each burrow, or rat hole, should be as small as possible in order to attain the desired result. It should be borne in mind that baits used for rats should always be of a different nature from the food they usually obtain. A change of bait is certain to be of considerable value, and when it is found desirable to lay down the poison a second time a different bait should be used. The bait should be as fresh as possible, as the vermin consume it more readily; if it is kept too long, the toxic properties may become weakened. It must be remembered that rats, especially old ones, are very suspicious animals, and if one of their number die from eating some particular kind of food, they will not go near that food for some time, unless it is artfully concealed, and judiciously placed; this no doubt accounts for the use of poison not always being attended with success, although large quantities of bait have been laid down. It has been suggested that in camps and barracks one bait per yard be laid on runs, and one pound allowed per hut, if badly infested. There is an objection to the use of poison in inhabited buildings, because the rats often die in their haunts (such as in a wall, or under a floor), and then it becomes a difficult matter to get at and remove their decomposing bodies, which consequently become a nuisance and a possible danger to the health of the occupants of the building. The putrifying body of the rat must be found, and it has been suggested that the following method be used in warm weather to detect the whereabouts of the dead rat. A number of blow flies are carefully caught without injury, and let loose in the room from whence the bad odour arises, taking care to close all windows and doors. After a time it will be found that the flies have a tendency to buzz round one particular spot, and this is probably the one where the dead body of the rat will be eventually found.

Professional rat-catchers prepare their bait in various ways, and the oils of musk, aniseed, carraway, rhodium, or cumin, etc., are often incorporated in the bait so as to make it attractive to the rats. Dyes, such as Prussian blue, black aniline, or chrome green, are sometimes used as colouring agents. Soot can also be used for the same purpose.

Arsenic.—This chemical is cheap, and has been recommended as a successful but rather slow poison for rats. It gives variable results. Hinton says " Arsenic is recommended by one very experienced rat-catcher as the best and safest poison, because in the small doses necessary to kill rats it entails little risk to domestic animals; if they find and eat the body of a rat so poisoned the small quantity of arsenic in the body is said to act upon them merely as a purgative." There are various methods of making up bait containing arsenic and the following formulæ are recommended :—

(1)	Arsenious acid	1 part.
	Oat or maize meal	12 parts.

The ingredients are mixed together into a dough with the white of an egg, a few drops of oil of aniseed being added.

(2)	Arsenious acid	1 part.
	Wheat flour, or oatmeal	12 parts.
	Lard, or suitable fat .. Sufficient to make a stiff dough.	
(3)	*Mr. Read's Formulæ*—	
	Water	80 per cent.
	White arsenic	6 ,,
	White lead	8 ,,
	Oxide of iron	6½ ,,
	Treacle, sugar, and make up with 20 per cent meal of aniseed.	
(4)	Make a dough of wheat flour, oatmeal, etc., with lard and treacle, and add 10 per cent arsenic, or 2½ per cent. croton oil.	
(5)	White arsenic	1 lb.
	Cheese	1 ,,
	Glycerine	1½ oz.
	Water	3 pints.
	Corn meal	2½ lb.
	Oil of aniseed	⅛ oz.
	Black aniline .. Sufficient to colour.	

Melt the cheese and the glycerine in one-third of the water; add corn meal and remainder of water, while heating; continue heating until meal is cooked; stir in arsenic, aniline and oil of aniseed, and pack in tins.

N.B.—In each of the above add a globule of mercury per lb. of bait.

The following is an old English formula :—

(6)	Oatmeal	1 lb.
	Brown sugar	1 ,,
	Arsenic	1 teaspoonful.

Strychnine.—This chemical is sometimes used as a poison for rats; its action is rapid, and may cause the rodents to die in their holes. It can be made up into a suitable bait with sugar and powdered biscuit, oatmeal or flour, with the addition of one of the essential oils mentioned previously, to make it attractive to the rats. The crystals of strychnia sulphate may be inserted in pieces of raw meat, fish, etc. The solution can be prepared by dissolving half an ounce of the salt in one pint of boiling water, adding one pint of syrup; the bait, such as maize or wheat, being afterwards soaked in the diluted syrup.

The following formula containing strychnine is recommended by Rosenau :—

Strychnine	1 oz.
Cyanide of potassium	2 ,,
Eggs	1 doz.
Honey	1 pint.
Wheat or barley	30 lb.

Stir eggs well, then mix in honey and again stir. Then put in dry powdered strychnine and cyanide and stir until well mixed. Put wheat in large box or can and pour in the mixture of poison and stir until it is well distributed over the wheat. Stir two or three times during twenty-four hours, then spread out and dry."

The greatest care must be exercised in the preparation of bait containing strychnine, owing to the very poisonous nature of this chemical.

Phosphorus.—Preparations containing phosphorus are effective when consumed by rats, and a large proportion of the rat poisons on the market contain this chemical. Phosphorus is, however, a somewhat dangerous substance on account of its inflammable nature. Very quickly, however, rats learn to avoid this poison, and its use should alternate with others. It can be made up into the form of a paste, which is prepared by using a fat base, such as lard, in which one to four per cent of yellow phosphorus has been dissolved; the paste is afterwards spread on bread, cheese or meat for use as bait.

The following method of placing the bait is recommended: Two wooden boxes are used, one considerably larger than the other, and each having two or more holes in the sides large enough to admit rats. The bait is placed in the bottom and near the middle of the smaller box, the larger one being then inverted over the smaller one. The boxes should be painted a distinctive colour. A receptacle containing water is placed in the vicinity of the bait for the rodents to drink; this accelerates the effect of the poison. Phosphorus does not mummify the dead rat's body, as popularly supposed.

Barium Carbonate.—This is a very efficient and safe rat poison; it is tasteless and odourless when conveyed in a proper medium, and has a corrosive action on the mucous lining of the stomach, causing thirst, thus inducing the vermin to seek water (which should be supplied for their use) in the open, where they die. In small doses barium carbonate is harmless to the larger domestic animals, but baits should not be placed where cats, dogs or poultry can obtain access to them.

The bait can be prepared as follows:—

(1)	Barium carbonate	1 part.
	Meal	4 parts.
	Water .. .. A sufficient quantity to make a stiff dough.	
(2)	*Mr. Read's Formula*—	
	Barium carbonate	6 oz.
	Flour, meal, &c.	16 ,,
	Salt	½ ,,
	Butter, lard, etc. .. Sufficient only to bind the mixture.	

The above quantity is sufficient for 1,000 baits.

Knead into a dough, roll out, and cut into ½ inch cubes. Barium carbonate may also be used in a dry form mixed with meal, etc., in the proportions of one part to eight parts of meal, or spread on fish, or moist toasted cheese.

(3 Prepare a dough as for ginger nuts, only thinner, and omit the ginger and fat, but add a few drops of oil of aniseed, rhodium, or carraway. Thicken the dough with twenty per cent by weight of barium carbonate, and bake in greased tins, with divisions of the size of an "oxo" cube. These biscuits baked hard will keep some time, and one of them is the proper size for laying out. The use of barium carbonate as a poisoning agent in bait is said to retard decomposition to a certain extent.

Squills.—The diluted extract of squills (sea onion) has now been added to the already large number of rat poisons, and it has an apparent action on the heart of the rodent. It is put up (1) in a proprietary article, called "Ratinol," made by the "Ratinol Company," 30, Mark Lane, London.

(2) The Extract of Squills, which can be obtained from Haller and Co., 60, Bishopsgate, London, E.C.2. The extract is in two forms : (*a*) in a state in which it requires dilution with two parts of milk or broth previous to being mixed with grain or bread. Directions for use: To one gallon of squills extract add two gallons of boiled milk sweetened by one pound of sugar, or two gallons of meat broth, and mix together. Pour the three gallons of liquid over thirty pounds of flaked oats, or stale bread cut into small pieces, and mix thoroughly by means of large spoons or flat sticks. The bait will then be ready. It should be laid in the afternoon, placed in small heaps wherever the rats are likely to find it. Spoons should be employed in laying the bait. The squills extract should be used without delay after it has been received, and the bait must be laid the same day as it is made. (*b*) As a mixture, "Danzo Rat Killer," containing the squill extract and a suitable broth in proper proportions, ready for use after being mixed with grain (flaked oats) or stale bread cut into small pieces.

(3) Mr. Read's formula is as follows: Red squills, in bulbous form; squeeze out the liquid; dilute one part with two parts distilled water; to this add an equal volume of milk or meat broth; cut up a two-pound loaf of stale bread into small cubes and soak thoroughly.

(4) *Scilla maritimus* preparation: A well-known Continental way of destroying rodents is to bake a pancake-egg (pancake not essential, but beef-dripping advisable) to which twenty per cent. of finely-chopped *Scilla maritimus*, red variety, is added, either to the batter before frying, which is simpler, or placed between two layers of pancake after frying. When cold, the pancake should be cut in pieces of about half an inch square and laid in the rat runs or holes. Rats are particularly susceptible to the effect of *Scilla ar.* (squills).

Plaster of Paris.—This is sometimes used to kill rats when mixed with flour, oatmeal, grated cheese, or other suitable ingredients. Fletcher-Barrett, on the subject of this rat-killer, says: "Plaster of Paris (dried calcium sulphate), mixed with sugar and flavoured, has long been used as a rat poison, the *modus operandi* being to place the mixture in accessible places, and near thereto to place bowls of water, the theory being that the rats will eat freely of the mixture, which creates an intense thirst, and then drink of the water. The calcium sulphate is thereby hydrated, and, setting hard in the interior of the rat, literally 'stiffens' him. It seems an unnecessarily cruel method of killing, but, fortunately for the rat in this instance, theories do not invariably work out in practice."

(*To b3 continued.*)

WARD CONSERVANCY.

A Scheme for Tented General Hospitals.

By Captain FREDERICK A. ANDERSON.
Royal Army Medical Corps.

Among the many problems that confront the sanitary officer in a hot climate, one of the most important is the prevention of fly-borne disease. This is essentially difficult in a General Hospital under canvas where the wards are necessarily open, and the greatest care must be exercised not alone to keep the tents free from all material likely to attract flies but also to prevent their access to anything that is likely to be infective, such as bed-pan contents, urine, sputum and vomit. It is not sufficient that the containing receptacles be covered but they must be removed from the wards and their neighbourhood and disposed of without delay. Thus far the problem is comparatively simple of solution and it is only when one comes to deal with the place and method of disposal that difficulties arise. Bed-pans not emptied or improperly cleaned; covers not replaced; liquid spilt about the floor; the accumulation of specimens for inspection; these and a host of other irregularities necessitate constant supervision, and it is no easy matter to fix the responsibility or discover the offender.

The importance of these considerations urged the writer to work out the system about to be described. This has been in operation in a Tented General Hospital in Macedonia during the summer and, while probably still admitting of improvement, has proved itself simple, efficient and almost fool-proof.

The general principles are as follows :—

Each group of wards is provided with a bell tent, known as the *sanitary tent*, in which are kept all the bed-pans, urine bottles, sputum cups and night stools belonging to the wards which it serves. This is placed conveniently in or near the lines and contains nothing but the utensils mentioned, *clean and ready for use.*

To each two or more groups there is attached a small shed, known as the *sanitary station*, for the reception of all *dirty* receptacles, immediately after use. Here they are dealt with by a man specially detailed and instructed, who alone is responsible for the proper disposal of their contents and their disinfection and cleansing. It is the duty of the ward orderly to fetch the bed-pan, urine bottles, etc., from the sanitary tent to the patient and after use carry it straightway to the sanitary station where he receives a clean one in exchange. He has thus nothing to do with the cleaning of pans and bottles, an arrangement which has many obvious advantages. The sanitary station is, of course, open day and night, and the man in

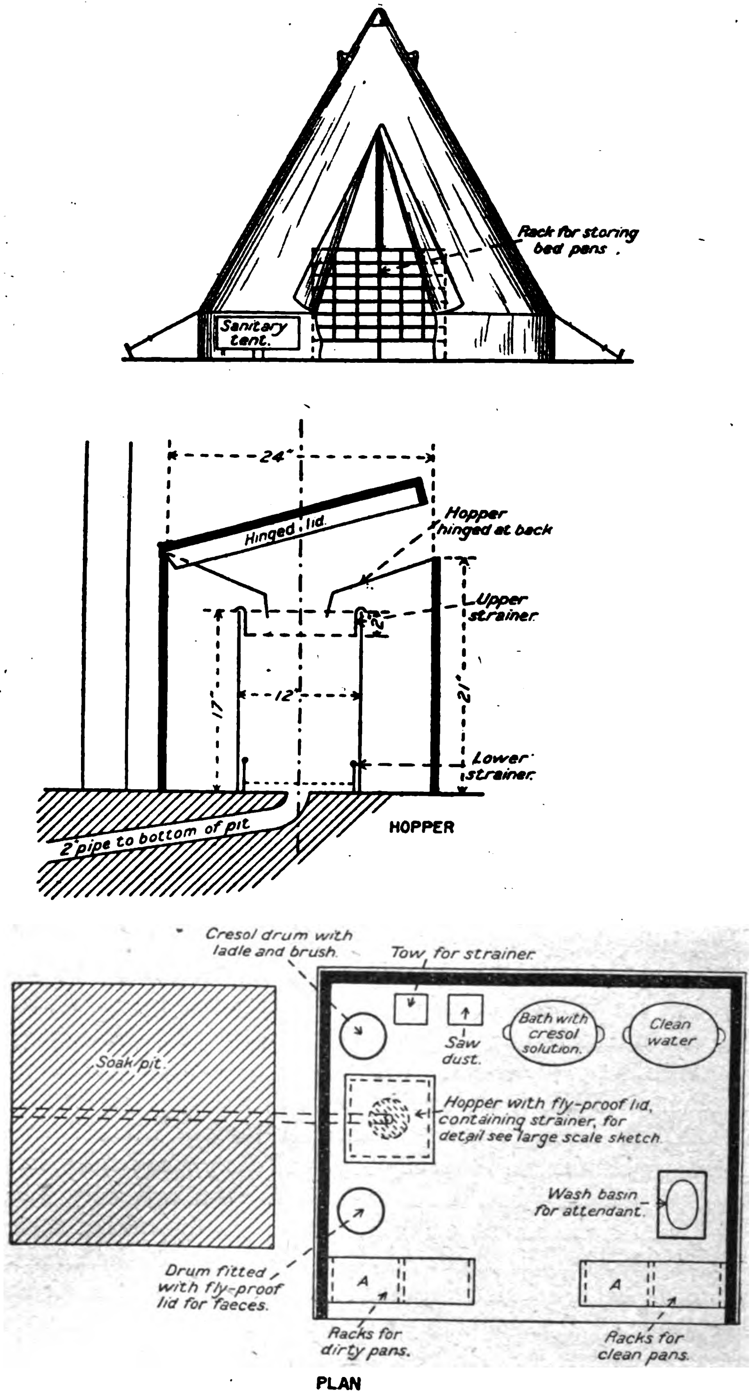


Fig. 1.—Sanitary tent.

charge by day can easily perform other duties in the immediate vicinity, so that no extra labour is involved. By night it is quite practicable for one man to manage two stations.

The equipment is not difficult to construct provided one can command the services of a joiner and a tinsmith. *The sanitary tent*: For this purpose a bell tent serves admirably. It contains a wooden rack (fig. 1). large enough to hold all the bed-pans, urine bottles and sputum cups of the group of wards to which it belongs. This can be made very conveniently from condensed milk boxes. Night stools are arranged upon the floor.

This tent, although properly belonging to the wards, is under the direct supervision of the sanitary officer, and nursing orderlies from the ward staff are detailed in turn weekly to keep it clean, a roster being posted in the tent. Typewritten instructions are exhibited to the following effect :—

(1) All bed-pans, urine bottles, sputum cups and night stools belonging to —— division will be kept in this tent, clean and ready for use.

(2) When required by a patient, they will be taken to the ward by the nursing orderly, and after use will be covered with a cloth and carried immediately to the sanitary station.

(3) They will be placed in the rack marked "dirty" and in exchange a clean one will be taken from the rack marked "clean" and returned to the sanitary tent.

(4) Under no circumstances will dirty utensils be placed in this tent nor be allowed to remain in the wards.

(5) The tent will be kept in good order by the nursing orderly detailed, who will be responsible that the above instructions are complied with.

Specimens for Inspection.

When a specimen is required for inspection by the medical officer a label will accompany the bed-pan, or other utensil, to the sanitary station stating :—

Name of patient.
Ward.
Date and hour.

The Sanitary Station.—This is a small shed (fig. 2) freely ventilated and situated at a convenient distance from the lines. It is quite inoffensive and does not attract flies, hence its position is solely dependent on the distribution of the wards with a view to accessibility. The floor is about 9 feet by 7½ feet and the wall, sides and back extend to about three-quarters of the height and are open above. The front is open and on each side of the entrance stands a small rack made of milk boxes, that on the left for dirty utensils, and that on the right for clean. Against the left-hand wall is placed a wooden box with overlapping lid hinged at the back. The box is bottomless, the sides resting upon the floor. On raising the lid

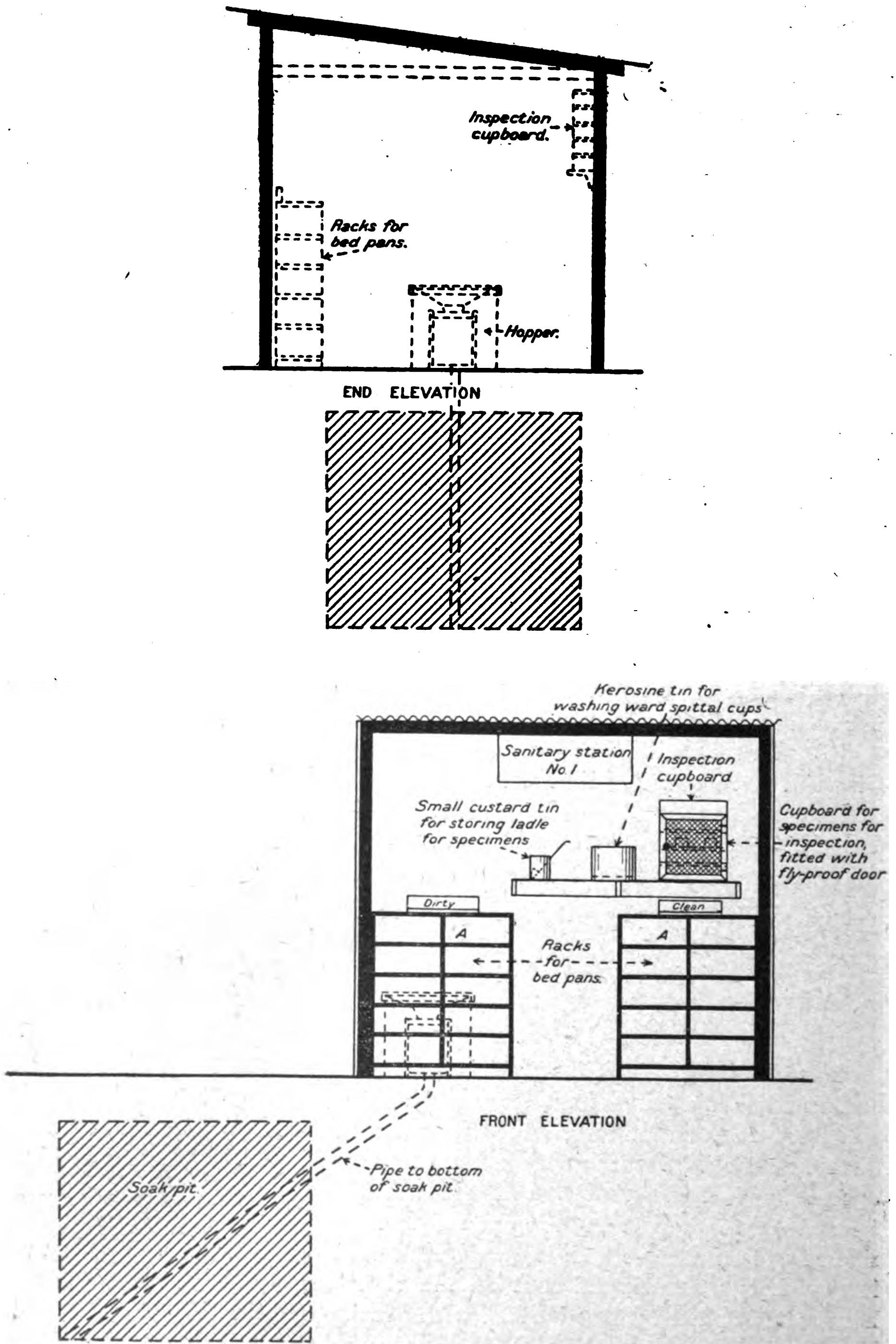


Fig. 2.—Sanitary station at General Hospital.

a tin hopper is seen, supported at the edges by the sides of the box and also hinged behind. This has a three-inch fall from the edge to a six-inch square opening in the centre, from which a broad lip turns downward as a funnel. Under the hopper is a cresol drum containing two perforated trays to act as strainers. The upper of these for coarse filtration is suspended by hooks from the rim of the drum, while the lower for finer filtration rests on the bottom.

Both trays are made to lift out for cleaning. An opening in the floor of the drum leads by a pipe to the bottom of a soak-pit immediately outside the shed.

On the right of the box is a drum filled with cresol solution 1/80 in which lie a metal ladle with long handle and a brush, while on the left is an empty drum with loosely fitting drop-on lid to hold excreta. Two baths are required for cresol solution and plain water respectively. Kerosene tins, open at the top, serve to hold sawdust and straining material. A drying cloth, and wash-hand basin with soap, nail-brush and towel complete the equipment for the routine cleaning of utensils.

The disinfection of sputum cups is carried out in a separate receptacle containing cresol solution.

For collecting specimens a small tin scoop is used and this rests in antiseptic solution. By means of it a portion of the stool is transferred to an empty custard tin, covered with a drop-on lid and placed in a shallow fly-proof cupboard. Thus bed-pans are never kept, medical officers seeing all specimens at the station in the tins which may then be sent to the laboratory if necessary. The tins and their contents are incinerated at fixed hours.

The following instructions are issued to the man in charge:—

Bed-pans and Night stools:—

(1) Place a clean layer of tow in the upper strainer and a circular piece of sacking in the lower.

(2) Take the bed-pan from the rack marked "dirty" and empty through the hopper, using the ladle and brush to clean it. All washings must be poured through the strainer.

Close the lid of the box.

(3) Steep the pan in the cresol bath for ten minutes and then wash out in water and dry with a cloth.

Place in the rack marked "clean."

(4) Remove the upper strainer and empty tow and fæces into the empty drum, cover with a handful of sawdust and replace the lid.

(5) Return strainer to position, lower the hopper and wash down with cresol. Lay a fresh layer of tow and close the lid of the box.

The sacking in the lower strainer need only be renewed daily.

(6) Wash your hands with soap and nail-brush.

(7) When the excreta drum is half full it must be taken to the

incinerator and the contents burnt. The drum must then be cleaned with cresol.

Specimens for Inspection.

When a specimen is required for inspection by the medical officer a label will accompany the bed-pan, etc., stating :—

Name of patient.

Ward.

Date and hour.

In such cases transfer a portion of the material to a clean tin, cover with a lid and place in the Inspection Cupboard, with label attached.

In the case of bed-pans the special scoop will be used, and this must afterwards be cleaned over the hopper and replaced in the tin provided.

All tins and contents will be incinerated at 12 noon and 7 p.m.

Urine.—Empty through the hopper. Wash the bottle in the cresol bath and in water, dry and place in the "clean" rack.

Sputum and Vomited Material.—Empty direct into the excreta drum. Wash over the hopper as for bed-pans.

Sputum cups must be steeped in a special receptacle for the purpose.

Dysentery and Enteric Sections.

These are of course the most important and here the method employed is slightly modified. There is no soakage pit, but just outside the station is a small field kitchen constructed to take cresol drums.

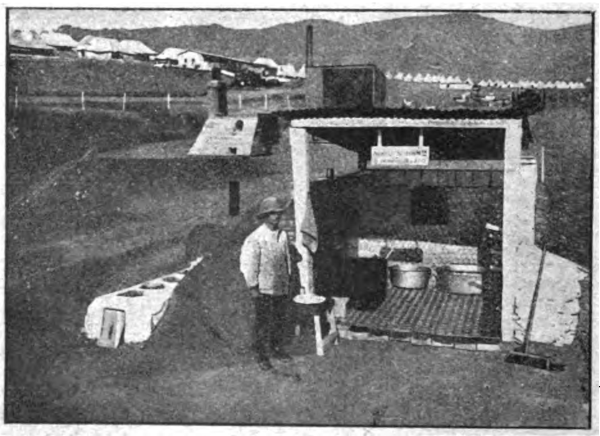


Fig. 3.—Sanitary Station. Dysentery and enteric.

The bed-pan contents go through the hopper into a water-tight drum without any filtration and when this is three parts full it is covered with a lid and transferred to the field kitchen where it is boiled for thirty minutes. Meanwhile a second drum takes its place under the hopper.

When boiled the fæces and washings may be disposed of in the same way as the contents of ordinary latrine pails.

Bed-pans and urine bottles are rinsed in a cresol bath 1/50 and then left to soak in a similar bath for fifteen minutes.

The foregoing description is necessarily somewhat tedious because the whole success of the scheme depends entirely on strict attention to detail. One need only say, however, that in actual practice the working of the stations is so uncomplicated that any man of average intelligence can be trusted to carry out the instructions without difficulty.

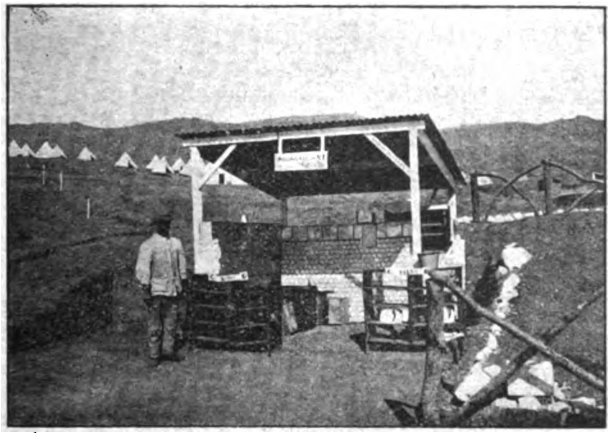


FIG. 4.—Sanitary Station. General Medical.

The claims made for the system are :—

(1) Freedom of the wards from infective material and consequent diminution in the number of flies.

(2) Prevention, as complete as possible, of access to this material by flies.

(3) Responsibility for the proper disposal of excreta and cleaning of utensils confined to one man.

(4) Bed-pans never remain dirty when stools are required for inspection. Convenience of tins for this purpose and for laboratory work.

In conclusion the writer wishes to thank Lieutenant-Colonel N. J. C. Rutherford for his kindly help and encouragement.

Much credit is due to Serjt. Bannerman (sanitary serjeant), Cpl. Whitehead (joiner), and Pte. Oakley (tinsmith) for their skilled assistance in carrying out the work, and to Cpl. Raistrick, R.E., for his kindness in preparing the diagrams.

Clinical and other Notes.

A FEW SUGGESTIONS FOR THE ARRANGEMENT AND MARKING OF MICROSCOPIC SLIDES IN A CABINET.

By Major J. E. M. BOYD, M.C.
Royal Army Medical Corps.

In cases where additions have to be made, almost daily, to a collection of microscopic slides which it is desired to retain permanently for reference or demonstration purposes, it has not been found possible in many cases, owing to lack of space, to reserve a separate drawer for each series of specimens.

Each specimen should therefore be labelled and numbered as it is prepared, and should be arranged in numerical order, quite regardless of the section to which each specimen belongs. A register is kept of each specimen, which is entered as soon as it is prepared, giving more detailed particulars than it is usually possible to include on the slide label.

This register should always be kept either on top of or near to the slide cabinet, so as to be available for reference at any time. By means of careful cross indexing it should be possible to look up any required slide in a few minutes.

For example, "cellulitis" would be entered in the index under (*a*) cellulitis; (*b*) inflammation; (*c*) skin or whatever part was infected.

Regarding the numbering and labelling. Printed numbers in sheets from 1-9,000, each sheet containing 1,500 consecutative numbers can be obtained at 2d. a sheet from Messrs. Watkins and Doncaster, Strand, W.C., or a series of the six sheets printed on five different coloured papers (thirty sheets in all), for 4s.

Labels. It is advisable to have these printed either with the owner's name or the name of the laboratory to which they belong; such labels can be obtained from Messrs. Suttley and Silverlock, Blackfriars Bridge Road, S.E., at 3s. 6d. a thousand, provided five thousand are taken at one time.

Indian or China inks are the best for writing on the labels as they do not fade. The order to which the specimen belongs should be written in block letters in red, the genus in green, and the species and further details in black, or what is usually more convenient, the order in red and the remaining details in black.

In cases where a register is not kept the following method of marking the slides in addition to the numbers and labels has been found most useful; it is also useful should the register be mislaid.

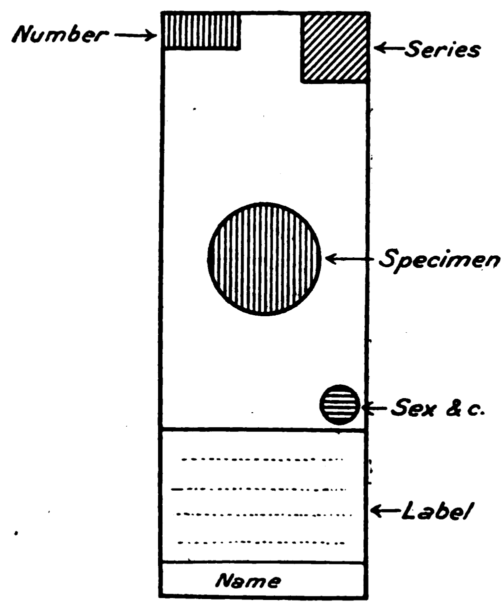
Small squares and circles of coloured papers are prepared and are fixed to the slides, these are affixed as follows: Those indicating a series of specimens, at the upper right hand corner of the slide, the number of the slide being at the upper left hand corner; those indicating sex or dissections, etc., above the upper right hand corner of the label which is at the lower end of the slide.

For example: if a red square is used for all the series of slides of the culicidæ and a blue circle to denote females, then a female mosquito would be

indicated by a red square at the upper right hand corner of the slide, with a blue circle above the right hand upper corner of the label. Parts and dissections can be indicated by a second, say a black, circle to the left of that denoting the sex, where the latter is known, or simply a black circle where the sex is unknown.

Thus a specimen showing the internal organs of a female mosquito would be marked by a red square above and black and blue circles below.

It has been found in practice that half a dozen colours are all that are needed, as combinations of colours in pairs, as red square green circle, can be used for the slides, should many different series be needed. All that is required is to remember that the marks at the upper end of the slide denote the series only. By this method it is possible to find any required slide in a drawer at once, without the necessity of reading all the labels and is therefore useful in saving time. In addition, providing the coloured labels are affixed evenly, the general appearance of the collection is greatly improved.



It may be thought that the above method is a waste of time, but as the coloured papers can be prepared at leisure this is not so; they can be cut at any time and if kept in pill boxes do not become mixed. The colours should be as far as possible permanent and can be obtained from theatre posters of the better class of advertisements, or covers of magazines. The circles can be cut by means of a punch for cutting wads for a 22-bore rifle or a leather cutter; the latter costs about 8s.

The squares are best cut by hand, and should measure about ¼ inch across. Married officers can get their wives to do this for them as it is easy work, but cutting through several thicknesses of paper is rather hard.

As regards the upkeep of the register, this should be done by the officer in charge of the laboratory and not left to subordinates, otherwise the cross-indexing

is liable to lead to trouble. I obtained the idea of this method of marking slides from Professor G. H. F. Nuttall, F.R.S., at the Quick Laboratory, Cambridge, who uses it for marking various stages of development of specimens on the slides in his collection; the marking of series also was thought out after seeing his specimens.

PYREXIA NOT YET DIAGNOSED, OF DENTAL ORIGIN.

By Captain HERBERT WALLIS.
Royal Army Medical Corps.

The following observations are given with a desire to point out to medical officers—particularly those in the tropics—a factor which may help them to eliminate the not yet diagnosed from the classification pyrexia not yet diagnosed, in some cases under their care.

It should be emphasized that in these days of dental decay (and in certain classes of dental neglect), an oral examination in cases of what would otherwise be labelled pyrexia not yet diagnosed will reveal a definite cause and diagnosis, leading to immediate treatment and more rapid cure of patients.

Whatever may be the original causes, it is a clinical fact that septic conditions of the teeth and gums are of serious import in tropical climates, as there seems to be a tendency to more rapid development of the virulency of pathogenic organisms in the mouth giving rise to vague pathological conditions leading to definite disease.

Amongst the cases admitted into the hospitals of Divisional Area, E.E.F., a certain number are labelled on their Field Medical Cards or A.F. B256 as pyrexia not yet diagnosed.

Their blood films and cultures give negative results for malaria, relapsing fever, and for the enteric group.

In the absence of any apparent cause of fever the dental surgeon is called in for advice and treatment.

I examine the mouth for septic teeth and roots causing inflammation and pus-discharge, and for evidences of pyorrhœa alveolaris, or for general neglect of the teeth.

(*a*) In cases where there are septic teeth and roots causing inflammation, these are extracted, and a warm mouth-wash such as 1 in 120 lysol or any similar solution, is used every two hours; in addition, the mouth is syringed out two or three times in the manner described later. Under this treatment the temperature goes down, and the patient is ready for discharge in a few days.

(*b*) A frequent cause of pyrexia not yet diagnosed (particularly amongst Indian troops) is pyorrhæa alveolaris.

The routine treatment for this is:—

(1) Thorough scaling.

(2) Syringing the gums under pressure three times daily.

(3) Local application of mist. dent. arsen.

Of these treatments special attention is given to syringing under pressure.

For this purpose I use a rubber Higgenson's syringe, adapting a metal or vulcanite nozzle, the size of the bore being a little larger than the lead in a lead pencil; this gives a fine powerful jet or stream of fluid which is capable of forcibly penetrating between the teeth and within the gum-margins. An orderly works the syringe bulb with both hands, using as much force as possible.

The operator is protected from the spray thrown back by a sheet of glass or celluloid held in front of patient's mouth.

A warm solution of 1 in 120 lysol or similar solution is used.

The syringe being worked by an orderly, I pass the nozzle along the gum margins, on internal and external aspects, and by means of this fine, powerful stream of fluid directed within the gum-margin, all deleterious matter is removed.

This syringing not only effects a thorough cleansing, but is stimulating to the diseased gums.

This syringing treatment is given two or three times daily, depending on the intensity of the condition.

Pyorrhœa alveolaris is very prevalent amongst the Indian troops, and, in addition, is, in many cases, the cause of anæmia, debility and other forms of sickness amongst them. A special ward is allotted for these cases for convenience of treatment, and to prevent the spread of infection.

Large concretions of tartar are often found, causing ulcers on cheeks and tongue. Thorough and extensive scaling is performed.

The Indian orderlies are trained in the use of the pressure syringe and patients are paraded regularly for this treatment. The results are most beneficial, the gums soon take on a healthy aspect, pus-discharge gradually lessens and ceases, the patients soon regain their normal health. The treatment lasts from four to ten days.

(2) A mouth application of mist. dent. arsen. is given. Mist. dent. arsen. is composed of:—

℞	Vin. ipecac.	ʒii
	Liq. arsen.	ʒi
	Glycerin.	ʒii
	Aquam ad	℥viii

This mixture is issued in two-drachm bottles (to obviate self-poisoning).

Three drops should be used twice daily; apply one drop at a time on the toothbrush. The gums should be gently brushed with this mixture on the brush.

The following are a few clinical cases showing the course of the illness and results of treatment. Copied from their Field Medical Cards.

(*a*) Miss ——, St. John Ambulance Brigade. History of previous attacks of malaria. Admitted August 10, 1914. Shivers and spleen region tender. Temperature 102° F. Patient in bed and obviously ill. Whilst waiting for further evidence of another onset of malaria, the mouth was examined, three carious molars found in right upper jaw, causing inflammation and foul-smelling discharge from gums. No quinine or other treatment for malaria was given. August 11, 1919: Teeth extracted. 14th: Patient greatly improved; temperature normal. 16th: Patient discharged.

(*b*) Pte. B. Date admission August 30, 1919. Combined Field Ambulance. Diagnosis: pyrexia not yet diagnosed.

Admitted Combined Clearing Hospital, September 1. Diagnosis: anæmia; patient has septic stumps left lower jaw, causing abscesses. Foments used. August 8, 1919: Gumboil disappeared, still anæmic. 10th: A.T. "Abbassia." September 13: Admitted Casualty Clearing Station.

To see dentist. Abscesses and swelling left lower jaw; all septic roots and teeth extracted. Patient was not confined to bed, but up doing light duty and soon became fit.

(*c*) Pte. —. September 10, 1919: Headache, vomiting. Temperature 103° F. Field Ambulance Diagnosis: malaria (?), relapsing fever (?). Bacteriological results negative for above. 13th: To see dentist. Many septic roots extracted. 14th: Temperature normal. Patient discharged a few days later.

(*d*) Pte. —. Field Ambulance Diagnosis: plasmodium malaria, benign tertian. Casualty Clearing Station, date of entry September 11, 1919. Ill two days. Temperature 99·4° F. Temperature began at 106° F. Headache and sore throat. September 11th: Film negative for malaria. 12th: Film negative for relapsing fever. 15th: Mist. alb. 16th: Visit dentist. Extraction: $\frac{6 \mid 6}{6 \mid 6}$. These teeth all decayed and septic, causing inflammation of gums with purulent discharge. 17th: Discharged a few days later.

(*e*) F.M.C. A— C—, Indian Driver. Admitted September 25, 1919. Field Ambulance Diagnosis: pyrexia not yet diagnosed. Temperature 24th, 100° F. Temperature 25th, 98° F. Temperature 26th, 98° F. Onset of illness six days ago. Admitted for pyrexia. Teeth carious; tongue clean; patient is sick; fever evening; motion muddy, loose.

This man came into dental surgery obviously ill, gait unsteady. He had extensive pyorrhœa alveolaris. Routine treatment used. Patient seen seven days after, his health greatly improved, and the gums normal, pus-discharge nearly ceased. Seven days later patient discharged cured.

(*f*) Pte. A. C. (2) R.A.F. Admitted Isolation Ward, August 29, 1919; temperature 106·6° F. Diagnosis: Pyrexia not yet diagnosed. Oral examination showed all upper (except four) teeth to be carious and septic with an acute inflammatory condition of gums. 30th: Temperature, 101° F. Three roots extracted by Medical Officer. Negative results for malaria and relapsing fever and enteric group. 31st: Headache less. September 3: Temperature normal. 5th: All septic teeth and roots extracted (under general anæsthetic). Discharged.

In this case after three extremely foul roots were extracted the patient began to improve. The mouth syringing treatment was carried out thoroughly prior to general extraction to keep down sepsis as much as possible.

TWO SUCCESSFUL CASES OF CERVICAL ŒSOPHAGOTOMY FOR REMOVAL OF FOREIGN BODY.

By Captain LEIGH DAY,
Royal Army Medical Corps,
Surgical Specialist, Curragh Military Hospital.

(1) George E., aged 5 years, was brought to the hospital on August 9, 1918, having swallowed a "whistle." The child was not distressed, but X-ray showed a large round body in the œsophagus with its lower end level with the vertebral end of the second rib.

The child was anæsthetized, and the œsophagus was exposed through an incision parallel to the right sternomastoid. The foreign body could be felt in the œsophagus, but just as an incision was about to be made over it, it slipped away lower down. It was hoped that the foreign body had passed on to the stomach, and the wound was closed.

On August 10, X-ray showed the foreign body to be level at its lowest end with the vertebral end of the fourth rib. The wound was reopened and a further attempt was made to remove the foreign body, but it could not be felt at all.

On August 14, X-ray showed the foreign body to be in the same position. The child was again anæsthetized, and the foreign body could now be felt. A bougie was passed through the mouth into the œsophagus, and the latter was opened by an incision on the bougie. Whilst an attempt was being made to remove the foreign body, the anæsthetic had to be stopped, as the child appeared to be dying from respiratory failure. The child was resuscitated and the wound drained.

On August 16, X-ray showed the foreign body to be again level at its lowest end with the vertebral end of the second rib. An anæsthetic was again given, and the foreign body was removed through the incision previously made in the œsophagus. The wound was drained.

The foreign body proved to be a large metal button, exactly the size of a florin in circumference, and as thick as three florins at its thickest point.

On August 17, gastrostomy was performed, and the child fed through the gastrostomy wound until September 12, at which date ordinary feeding was commenced. There was a profuse very foul discharge from the neck for about a fortnight, but otherwise recovery was uneventful.

(2) Pte. K. was admitted to the hospital on February 1, 1919, in great distress from severe dysphagia, having swallowed a bone.

On February 2, X-ray showed a piece of bone impacted in the œsophagus, at the level of the cricoid cartilage. Cervical œsophagotomy was performed on the right side of the neck. A small jagged piece of bone was removed through the opening in the œsophagus; a larger piece of bone, from which the smaller had broken off, was pushed up by the finger in the œsophagus, and removed through the mouth. The bone removed was extremely foul. The œsophageal opening was closed, and a drain was inserted down to the opening. The wound was closed.

On February 3, gastrostomy was performed, and the patient was fed through the gastrostomy wound till February 19. There was a profuse and very foul discharge from the wound in the neck until February 14. Recovery was uneventful.

Gastrostomy was performed in the first case on the suggestion of Colonel D. O'Sullivan, C.M.G., A.M.S., and to his suggestion both patients owe their lives. Cervical œsophagotomy should be a perfectly safe operation if gastrostomy is subsequently performed, but without it a recovery could hardly be looked for, owing to the extremely foul character of the discharge from the œsophageal opening, which would naturally be greatly accentuated by the leakage of food from the œsophagus.

I have to thank Dr. Coady, of Kildare, for his kind assistance in the first case, and Captain W. C. MacFetridge, R.A.M.C., in the second.

SUMMARIZED RESULTS AND OBSERVATION FROM AGGLUTINATION AND ABSORPTION TESTS BY THE TIME-GOVERNED SLIDE METHOD.

By Captain (Local Major) W. Broughton-Alcock.
Royal Army Medical Corps (Special Reserve).
Officer-in-charge of Laboratory, Infectious Diseases Hospital, Malta.
(Late Assistant Pasteur Institute, Paris).

The following summarized results and observations made during the war, from the practical application of my time-governed slide method for the agglutination test in cases arising in France, Gallipoli, Salonika, and Malta form an appendix to the publications of the technique of that method in the Journal of the Royal Army Medical Corps,[1] and may present points of particular or general interest to fellow workers. The test was carried out whenever possible and as part of a system of complete examinations on cases receiving laboratory investigation.

Bacillus Typhosus Vaccine.

During the years 1914-15 almost all patients or subjects examined had been inoculated with antityphoid vaccine. Of the sera tested all but one inoculated within two years showed specific agglutinin action on the *B. typhosus.*

B. paratyphosi A and B Vaccine.—Nearly 3,000 subjects were inoculated in Malta during 1915 and early in 1916 with *B. paratyphosus* A and B, treated with normal serum, vaccine made as I have described (*British Medical Journal,* August 8, 1914). The sera tested from a certain number thereof gave positive agglutination of both micro-organisms up to six months, and with *B. paratyphosus* B up to ten or twelve months after inoculation. Following anti-paratyphoid vaccine the agglutinin action for *B. typhosus* due to previous inoculations with the anti-typhoid vaccine was frequently increased.

T. A. B. Vaccine.—In subjects inoculated with T. A. B. vaccine it has been noticed that, as a general rule, agglutinin for *B. paratyphosus* A had diminished or disappeared first in point of time, whilst that of *B. paratyphosus* B remained longer, although the converse has been noted. That for *B. typhosus* remained the longest time.

[1] The previous papers appeared in the November and December, 1919, issues.

ENTERICA INFECTIONS.

Appearance and Disappearance of Agglutinins.—Specific agglutinin action arising from infection was present in the sera of patients towards the end of the first week of illness, except in occasional cases due to *B. paratyphosus* A, wherein it was not determined till the second week, while in one case it was not determined till the twenty-third and in another till the thirty-fourth day after the onset. Specific agglutinin for *B. paratyphosus* A developing in disease, when compared with the specific agglutinin developing for *B. paratyphosus* B, and especially when compared with that in *B. typhosus* infections, tends to disappear earlier from the sera, especially in short febrile cases; the variation in degree of *paratyphosus* A agglutinin action is great; occasionally it has been not only transitory but very small. The low dilutions used in the slide method have been helpful in detecting it.

Non-inoculated.—Enterica patients, who had not been inoculated frequently, gave sera that agglutinated within four minutes that emulsion only which corresponded to the micro-organisms with which they were infected.

When co-agglutinin action appeared, it was always later on in infections and these were almost all cases due to *B. typhosus*. Co-agglutinins did not produce agglutination as quickly in point of time, and their action was but rarely determined within four minutes in as high dilution of sera as the specific agglutinins. Only exceptional sera of cases due to *B. paratyphosus* B or *B. paratyphosus* A developed detectable co-agglutinins.

Cases inoculated with Anti-typhoid Vaccine.—Patients who had received anti-typhoid vaccine and were infected with any micro-organism of the enterica groups gave sera wherein the specific agglutinin for *B. typhosus* already present was, as far as one can judge, increased. When the cases could be examined early in their infections the results were simple of interpretation. Those due to *B. typhosus* gave sera that agglutinated only the emulsion of *B. typhosus*, while those due to either *B. paratyphosus* A or B gave sera that agglutinated the emulsion corresponding to the infecting micro-organism as well as the emulsion of *B. typhosus*. When tested late in the second or third week of the disease, cases due to *B. typhosus* not infrequently gave sera that temporarily showed slight co-agglutinin action for *B. paratyphosi* A and B. But such action was not as rapid nor detected in such high dilutions of sera tested on the slide as that of the specific agglutinin for *B. typhosus*. When tested in the second or third week of the disease cases due to infection with *B. paratyphosus* A or B appeared to increase the inoculation agglutinin content of sera for *B. typhosus*, especially when the infection was due to *B. paratyphosus* B. One group of the *B. paratyphosi* very rarely produced any co-agglutinin action in the sera for the other paratyphosus group.

The army routine measure of interval agglutination examinations which I have carried out previous to and from the opening of the laboratory of the first infectious diseases hospital in France (14th Stationary) in 1914 have shown almost constantly the specific agglutinin curves to be more prolonged.

Inoculated T. A. B. Vaccine.—In considering cases of infection with one of the three groups, one has had to make note that the sera of non-infected subjects do not give a corresponding reaction at any defined time after the T. A. B inoculation. Repeated interval examinations are essential to diagnosis, and one

has had to determine the time or titre curves marking the rise or fall of an agglutinin action in order to determine serologically the infection present.

Irregular Findings.—These are infrequent; but their incidence may be in part comprehended for reasons given in Article I and by the fact of the known variation in minor characters to be found amongst strains of a group of micro-organisms and the possibility of concurrent infections. In the *typhoid* group two uninoculated patients gave in the third week of their disease and just prior to death sera that failed to agglutinate the *B. typhosus* emulsion by the long method. The serum of another similarly uninoculated case dying in the third week of typhoid fever agglutinated, equally on the slide and by the long method, both emulsions of *B. typhosus* and *B. paratyphosus* B. Careful search failed to find *B. paratyphosus* B in association with the *B. typhosus* which was isolated before and after death. A fourth case that died and was uninoculated gave serum that did not agglutinate, in any of the several dilutions tried, the *B. typhosus* isolated, but did agglutinate the stock emulsion and several other strains of *B. typhosus.* The strain isolated was readily agglutinated by sera from five other patients suffering from typhoid fever. In the *paratyphoid* B group, two cases gave sera that transitorily agglutinated the emulsions of *B. paratyphosus* A and *B. paratyphosus* B in equal high dilution by a long method; though in point of time agglutination of the latter emulsion took place just before that of the former in the dilutions tested on the slide. One anti-typhoid inoculated case, from which *B. paratyphosus* B could alone be recovered from the blood, gave serum that, examined three times at seven days interval, did not agglutinate by my slide or by the long method in any of the several dilutions employed the emulsion of *B. paratyphosus* B, but agglutinated readily in low and high dilutions those of *B. typhosus* and *B. paratyphosus* A. The strain isolated had the fermentation, agglutination, and absorption character of a typical *B. paratyphosus* B. Two cases, of interest rather for a possible than a real danger in interpretation, gave sera that early after a clinically diagnosed relapse of *B. paratyphosus* A infection, when a *B. paratyphosus* B was isolated from the blood, agglutinated only the stock emulsions of *B. typhcsus* (due to inoculation) and *B. paratyphosus* A and not that of *B. paratyphosus* B nor the strain isolated. A week later in each case the specific agglutination of the *B. paratyphosus* B of the stock emulsion and of the strain isolated was detected. Absorption test on the above serum showed the agglutination to be due to specific agglutinins. In the *paratyphoid* A group, several cases gave sera that showed throughout the disease and convalescence agglutinin action for *B. typhosus*, because of previous anti-typhoid inoculation, more rapidly and to higher dilutions than that for *B. paratyphosus* A, although the latter bacillus was recovered from the bloods. In two other cases no specific agglutinin action for the strains of *B. paratyphosus* A, recovered from the blood, stock emulsion or two other strains of *B. paratyphosus* A, could be determined, during the illness or convalescence, by either my slide or the longer method.

B. Dysenteriæ Infections.

When the disease was due to *B. dysenteriæ* Shiga or Flexner-Hiss, the associated agglutinins in the sera, due to previous anti-enterica vaccination, were determined throughout the disease and, as far as one could judge,

were unaffected by the *B. dysenteriæ* infection. The specific agglutinin content present, or its later development in sera of bacillary dysentery patients, was not apparently influenced by antibodies formed in response to the injections of anti-dysenteric sera.

Double infections with *B. dysenteriæ* Shiga and *B. dysenteriæ* Flexner-Hiss have been indicated by the agglutination test and have been confirmed by the absorption test and in two cases proven bacteriologically.

B. dysenteriæ Shiga.—Specific agglutinin action for *B. dysenteriæ* Shiga in sera generally appeared between the seventh and sixteenth day following the onset of acute symptoms, rarely earlier. In two per cent of all cases no agglutinins were detected. A lesser co-agglutinin action on *B. dysenteriæ* Flexner-Hiss was detectable in about one-fourth of the cases.

The presence of detectable specific agglutinins in sera appeared in general to be dependent on the length of time the bacilli were acting pathogenetically. This agglutinin action not infrequently early disappeared. It occasionally persisted for some months and in many of these cases the acute symptoms in the intestine or nerve or joint complications were prolonged.

In a limited number of cases followed from the first or second day after onset, it appeared that when frequent salines were given alone or with anti-dysenteric serum early after the onset, and the temperature was raised only for three or four days, specific agglutinins were generally only slight and occasionally only transitory in the second or third week, though the onset was most acute and *B. dysenteriæ* Shiga very numerous in the stools during the first few days.

The sera of two cases, examined post-mortem and found to have no marked macroscopic lesions in the intestine, gave a positive agglutination. The sera of four cases, who died early in the disease and had extensive typical macroscopical lesions, gave no agglutination. *B. dysenteriæ* Shiga was isolated from all six.

B. dysenteriæ Flexner-Hiss. — A selected stock strain of *B. dysenteriæ* Flexner and one of *B. dysenteriæ* Hiss have been frequently employed simultaneously in the test mainly for interest and instruction. The difference of degree in which they are agglutinated in positive cases due either to *B. dysenteriæ* Flexner or Hiss is slight. For diagnostic purposes the strain of *B. dysenteriæ* Hiss "J" now in use for nearly two years is very reliable, and has proved itself the only reliable one from amongst many strains of the *B. Flexner-Hiss* group that were comparatively examined.

The variation in severity and frequent mildness of dysenteric symptoms in cases due to *B. dysenteriæ* Flexner-Hiss makes it difficult to determine what date after onset the agglutinin action appears.

Serum taken prior to and at the autopsy of two cases due to strains of the *B. dysenteriæ* Flexner-Hiss group did not agglutinate the stock emulsions nor the strains isolated. The lesions seen in the intestines were those seen in the severe type of bacillary dysentery. Death occurred early in the disease in each case.

Very rarely there is isolated from the fæces of a dysenteric patient a bacillus which corresponds in biological characters to typical strains of the Flexner-Hiss group and produces an agglutinin specific for itself.

M. melitensis and Hetero-Agglutinin Action in Sera.

Sera of patients suffering with undulant fever agglutinated also the micro-organisms corresponding to those previously given in prophylactic vaccines, but no rise in the titre of such sera for them was apparent.

On account of the variable prodromal symptoms in melitensis infections, the date of onset of the disease is difficult to determine. In over thirty cases the specific agglutinin action for *M. melitensis* was found present in the sera at the first tests made soon after admission to hospital. In two mild cases admitted very late in convalescence the agglutinin action for *M. melitensis* had disappeared, while that produced by anti-typhoid vaccine inoculation persisted.

Hetero-agglutinin for *V. choleræ* was present in the sera prior to true convalescence in the great majority of cases systematically examined from early after the onset of the fever. This hetero-agglutinin action was occasionally determined in the urines when also present in the sera, and only when the specific agglutinin action for *M. melitensis* was marked in the sera and also present in the urines. Absorption tests confirmed the findings.

During the fever a very transitory and slight agglutinin action for *B. dysenteriæ* Flexner-Hiss in two sera and for *B. dysenteriæ* Flexner-Hiss and *B. dysenteriæ* Shiga in one serum diluted 1 in 10 was noted. Hetero-agglutinin action was again confirmed by the absorption test.

The co-agglutinin for *M. paramelitensis* was found present to a very slight degree in rare cases, and only when the specific agglutinin was marked in its action.

In all cases and at all stages of the disease, the specific agglutinin was the first to show its action by the slide method.

As some authors have found a difference of action between non-heated sera and sera heated sufficiently to destroy its complement, a series of tests were made on several patients' sera. Sera tested before and after heating showed no difference in their agglutinin action on the strain used. Though the strain of *M. melitensis* has been systematically used when testing the unheated sera of patients suffering with any of many febrile diseases, it has never been agglutinated in 1 in 10 dilution of unheated serum within three minutes by my slide method unless the patient has undulant fever.

After following several cases for some six months or more, I have observed that late in true convalescence the hetero-agglutinin action for *V. choleræ* was not detected and the specific agglutinin for *M. melitensis* fell rapidly in titre, but in two cases only had it disappeared after two to three months.

It must be remembered that the emulsion of *M. melitensis* to be used in the slide test must be very dense in order to avoid an inhibition zone, which is occasionally seen even in a 1 in 10 and 1 in 20 dilution, should a thinner emulsion (of a density such as that of the other emulsions) be employed.

V. Choleræ.

During the War I have found only one serum from an uninoculated man that has shown specific agglutinin action for *V. choleræ*. He had come late from Serbia and was a foreigner. His serum did not agglutinate *M. melitensis*. In the

absence of experience of the time-governed test on many cholera infected patients I am not able to say if a 1 in 6 dilution of serum can be employed with more advantage than the 1 in 10 dilution.

Zones of Inhibition.

During the comparative testing of many sera, a few gave a specific and clearly positive result in a 1 in 10 dilution when the standardized emulsion was used and not when a thin emulsion was used. These examinations were made with sera from one man recently inoculated against typhoid, from two cases of typhoid fever, from one case of paratyphoid A fever, and from three cases of undulant fever. The sera from these cases showed similar negative results after twenty-four hours' contact with their corresponding emulsion in a 1 in 10, 1 in 20 and 1 in 40 dilution, but agglutinated it in a 1 in 80 and 1 in 160 dilution.

The zone seen present when using a thin emulsion of *M. melitensis* was not constant in the serum, for in two cases in the second examination of the sera, made within a few days, this zone was no longer present. There was no apparent dependence of the zone upon the duration or the severity of the infection.

Varied Agglutinability of Separate Colonies and of Strains.

The experiences such as the following are rare, but have an interest when strains are being selected for working upon, and when subcultures are being made.

A single colony of *B. dysenteriæ* Shiga that grew from a stool plating on Conradi's medium was replated on to the quarter area of another plate of the same medium to secure pure isolated colonies. One of the isolated colonies on plate 2 was agglutinated before and after successive sub-cultures on agar in a 1 in 50 dilution of anti-typhoid, anti-paratyphoid A and B, anti-dysenteric Shiga and Flexner sera (Lister Institute), and 1 in 10 normal human serum within two minutes. Another colony tested in similar dilutions of the same sera was only agglutinated by the anti-dysenteric serum, Shiga. Both colonies showed the morphological, fermentative and absorption characters typical of *B. dysenteriæ* Shiga. Again on examining isolated colonies from plating out a strain frequently subcultured and tested from time to time during some years, one colony was agglutinated in anti-Shiga and anti-Flexner-Hiss animal sera and not in other anti-sera tested nor in normal serum, while another colony was agglutinated in anti-Shiga serum only. These properties persisted in several subcultures made and tested.

The *paratyphosus* A. strain used in Professor Widal's laboratory and kindly given to me by him six years ago is employed in the test, as no better strain has been found for agglutination work. Once, some three years ago, it became inagglutinable, and the bacilli had grown up as cocci-bacilli, but the colonies isolated from an inoculation abscess following its injection were upon culture readily agglutinated. Recently on slightly dry media it grew in coccal form and was almost inagglutinable. Its bacillary form and excellent agglutination properties returned after twice subculturing the growth in agar tube condensation water or broth and then on moist agar tubes.

Most grateful thanks are extended to my collaborators and assistants who have worked with me during the long series of investigations which are herein summarized.

THE POSSIBLE USE OF *AZOLLA FILICULOIDES* AS A DETERRENT TO ANOPHELINE BREEDING.

By Captain MALCOLM E. MacGREGOR.
Royal Army Medical Corps.
Officer in Charge, Entomological Laboratory, Sandwich, Kent.

One of the activities of this laboratory during the past summer has been the careful study of anopheline breeding places in regard to the association of the larvæ with the common water weeds of this locality, to see whether there are any weeds inimical to the larval development.

In this work I have had the help of Captain G. Bryce, R.A.M.C., and his expert botanical knowledge. Captain Bryce while he was here collected a very large number of water weeds from the ponds in and around Sandwich, and prepared named specimens for the laboratory. Most of the weeds were subsequently studied individually as to their influence, if any, upon the development of anopheline larvæ in our artificial anopheline breeding ponds.

None of these plants were found, however, to have any marked effect one way or another upon the development, although our records show that the larvæ certainly prefer some to others.

Later, in a strip of dyke about a mile from the laboratory *Azolla filiculoides* was found to be growing luxuriantly, and forming a veritable carpet over the water surface. I had some of this plant brought to the laboratory and tested in the same way on the anopheline larvæ, but it too had no effect on the development.

The plant, which is exceedingly beautiful, being at some times of the year green, and at others of a magenta colour, was placed in one of our anopheline breeding tanks simply because of its ornamental qualities. The plant spreads rapidly, and in a week it had completely covered the surface of the water (see figure). At this time of the year the numbers of the local anophelines (*A. maculipennis* and *A. bifurcatus*) were at their height, and natural oviposition took place every night in our breeding tanks, so that large numbers of larvæ were constantly being added to our supply. Whenever larvæ were wanted in the laboratory it was the custom to make a "dip" into one of the tanks. It soon became obvious that the numbers of larvæ in the tank containing the azolla were speedily reducing and in about a fortnight when all that had been present previously had pupated and emerged no others were obtainable in spite of the fact that the other tanks contained enormous numbers of larvæ at all ages.

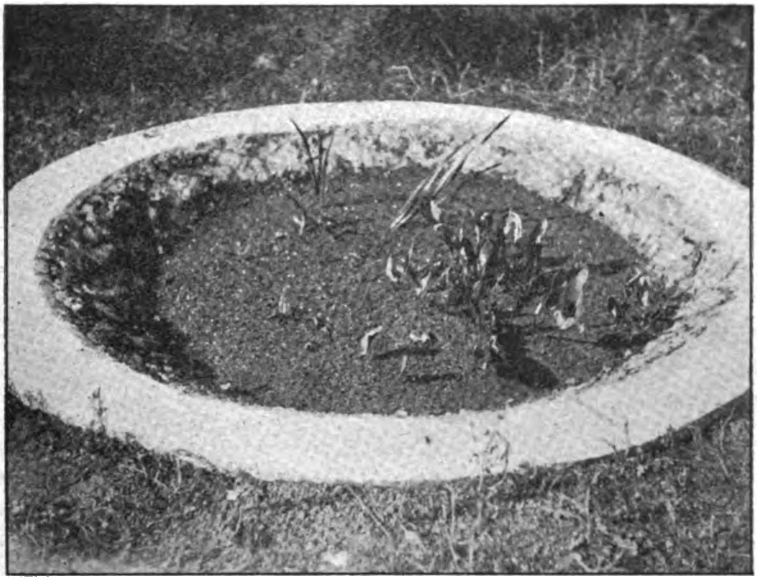
Some of the water of the azolla tank and a supply of the weed was then placed in a large circular dish and about 100 larvæ added. A control dish with the same water and the weed *Entromorpha intestinalis* was placed near by. The dishes were placed near the tanks and carefully observed each day. It was again found that the *A. filiculoides* had no detrimental effect on the larval development, *but whereas in the control dish large numbers of ova were laid each night by the wild anophelines no ova was deposited in the dish containing the azolla* which carpeted the surface of the water.

The azolla tank was left undisturbed throughout the season, except to be tested three times a week for the presence or absence of larvæ. In spite of the fact that the wild anophelines were abundant and laid continuously in the other tanks no larvæ were ever found in the azolla tank.

It is too late this season to do much more with the plant to gauge its possibilities in the natural ponds as a deterrent to anopheline breeding, by introducing this plant from the one source of supply I know of near Sandwich (and where, by the way, no larvæ have ever been found) into the other ponds where the anophelines breed in large numbers. I am, however, sure that this plant should prove next year when this work can be done, of very great value.

A. filiculoides is as I have already said exceedingly beautiful, carpeting the water with its foliage as a light green or a bright magenta pile according to the stage of growth in a remarkable manner. It is in this way very different to many of the common water plants of stagnant pools which so often to the average person are unattractive and unsightly forms of vegetation.

The plant belongs to the fern family, and is I understand a comparatively recently imported exotic from Canada.



Azolla filiculoides growing in one of the laboratory artifical breeding tanks. Note the water surface completely covered by the weed and the weed's close contact with the other water plants, which it is indeed in process of enveloping.

It is a floating plant with compact leaves forming a spongy mass raised about ½ inch above the water surface. The roots are thread-like and are about 1½ inch in length. There is no attachment either to the sides or bottom of the pond, and the plant may be gathered in masses by simply scooping it from the surface. In this manner a pond is very easily cleared of the weed if necessary. Its spreading powers are astonishing, and a single plant will in the course of a fortnight cover a large area. In fact, the covering of the water surface seems one of the aims of the plant, the smaller weeds being speedily smothered and killed out.

It is upon this power of completely covering the water surface that its deter-

rent action to the breeding of anophelines rests. Apparently the female anopheline mosquito must have an open water surface on which to lay her eggs in nature.

I have found by experiment here that the anopheline ova, even when the embryo is fully developed within the egg, cannot withstand drying for much longer than six hours, and whereas *Stegomyia fasciata* will generally lay its eggs *upon* damp water weeds floating on the water surface, the anophelines always lay their eggs on the water surface itself, seeming to avoid weeds as much as possible.

It is probable therefore that the female anopheline regards an azolla covered pond as a highly dangerous place as far as her eggs are concerned, since the ova are not capable of resisting desiccation to any extent, and it would be difficult for her, if not impossible, to reach the water surface in such a pond.

I look forward therefore with interest to introducing *A. filiculoides* into some of the chief anopheline breeding ponds next year, and anticipate considerable success by the use of this plant in rendering ponds unsuitable breeding places that have served the anophelines admirably heretofore.

I am indebted to the Director of the Royal Botanical Gardens, Kew, for the following information concerning *Azolla filiculoides*, Lam.

"The genus Azolla, Lam., belongs to the family Salviniaceæ, which was formerly placed in the Rhizocarpæ, but now in the heterosporous pteridophyta.

"*A. filiculoides*, Lam., is a native of the western side of America from California to Chile, and in the Andes ascends to an altitude of 16,000 feet. An account by W. J. Campbell of its structure and life-history can be found in the "Annals of Botany," vol. vii, pp. 155-187, tt. 7-9. It has been naturalized in many parts of Britain, and a résumé of this by A. S. Marsh has been published in the *Journal of Botany*, 1914, pp. 209-213, and supplementary notes in the same Journal by W. H. Burrell in 1914, p. 269, and H. Peirson, 1915, p. 308. It is propagated by means of male and female spores, which are produced freely, and towards the end of the season the plant turns from green to red, in a similar manner to the autumn tints of some trees."

DUG-OUT STEAM DISINFECTOR.

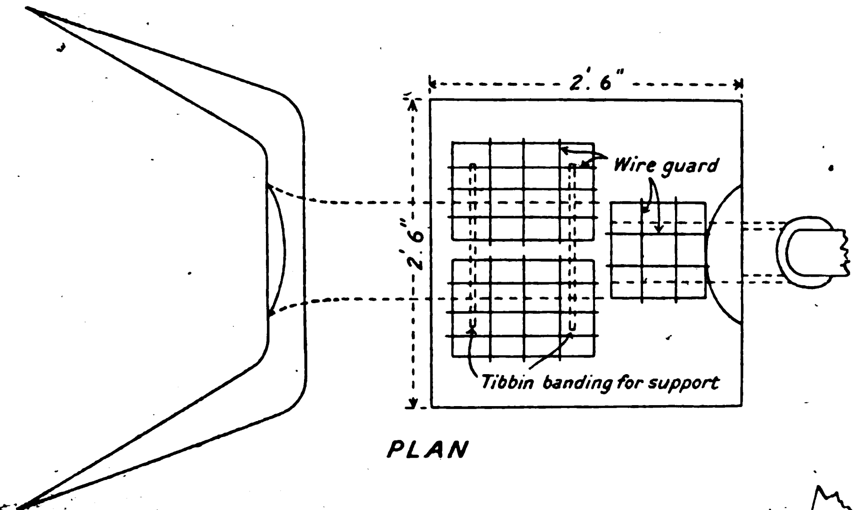
By Lieutenant-Colonel W. E. C. LUNN,
Royal Army Medical Corps.

Disinfection in field ambulances and other units which move from day to day is often a matter of urgency and yet of great difficulty.

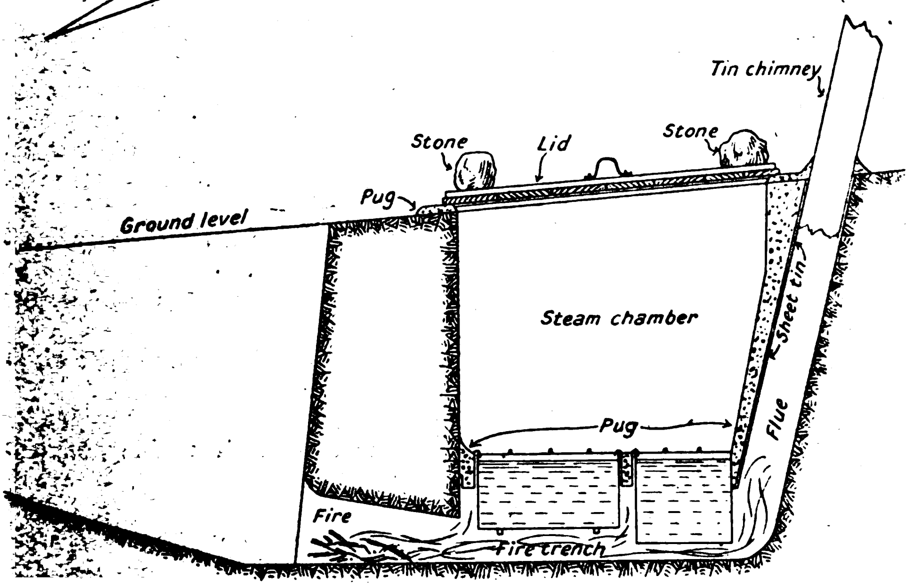
Thresh disinfectors and Foden lorries are excellent things in their way, but they were never intended to climb up to, or descend down to, some of the places whither the British Army has had to go nowadays.

Serbian barrel disinfectors are issued in some commands, but they are bulky (four barrels required for a battalion), and are not strong enough to stand constant removal and the hot sun of semi-tropical countries.

Built-up disinfectors, on a similar principle to field incinerators, have been constructed, but these take some time to build, and often the battalion moves before the disinfector can be taken into use.

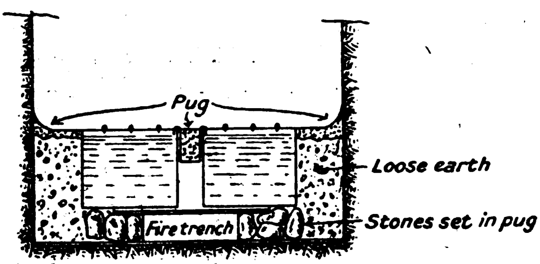


PLAN



LONGITUDINAL SECTION

Scale, 1 inch = 18 inches.



CROSS SECTION

Recently this field ambulance has had to deal with the lice-ridden clothes of occasional typhus cases, and it became essential to find some type of easily-constructed steam disinfector suitable for a temporary camp in the field.

Lance-Corporal W. W. Ladd, R.A.M.C. (T.), of this field ambulance, therefore determined to try and see if a satisfactory dug-out disinfector could be improvised rapidly. The first one made proved an immediate success; all lice were found dead and the eggs shrivelled and opaque, after exposure to steam of one hour.

This type of disinfector is always constructed now whenever the main dressing station is moved to a new camp. It can easily be made in five hours, and the only essential articles of construction necessary to be carried by the limited transport of a field ambulance are the lid and the tins in which water is boiled.

The drawings and description are by Lance-Corporal W. W. Ladd:—

Site.—Sloping ground. Pit two feet six inches square and three feet deep. Sloping dug-out to fire trench. Tunnel through to pit.

Materials.—Three kerosene tins (cut down as shown in sketch). Sheet tin (old biscuit tins) for chimney, and packing round flue to prevent heat from scorching clothing. Wooden lid, three feet square, packed on underside with old blankets or sacking. Tibbin banding for supports to tins. Tibbin banding, or wire, to form mesh over boilers, to prevent clothing falling in the water.

Setting of Tins for Boilers.—Tins are set over trench, formed with stones and pugging sides. Two inches space between tins, upper part of which are packed with pug, held in position with hooks of tibbin banding and lengths of sheet tin. Loose earth is packed between tins and sides of chamber. The bottom of chamber is pugged to complete surface.

Chimney Flue.—Chase side of chamber to form a flue; a tin chimney is cut and let in, and flue completed with tin and pugging surface.

Lid.—The ground is pugged round chamber to form sealing for lid, stones are placed on top at each corner to increase pressure.

Boilers.—These are filled with water to within one inch of the top, to which may be added a little formalin.

Fuel.—Wood, brushwood, and *dry* camp rubbish.

Capacity.—Five blankets (put in loosely) or two men's clothing, without blankets or greatcoats.

Time for Disinfection.—One hour.

ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

By Lieutenant-Colonel E. M. WILSON, C.B., C.M.G., D.S.O.
Royal Army Medical Corps.

On the occasion of our Benevolent Society attaining its hundredth birthday it is thought that a short account of its origin and growth may interest Officers of the Corps who subscribe, and perhaps induce others to support a charitable institution which is essentially their own.

The first meeting was held at 5, Berkeley Street, on June 8, 1820, with the Director General, Sir James McGrigor, in the chair, when it was proposed by the

Director-General and seconded by Dr. W. Franklin, "That a Benevolent Fund be established for the benefit of the orphans of Army Medical Officers."

Among the original Committee were Dr. William Franklin, a "principal inspector," afterwards knighted; Dr. William Somerville, Physician to the Royal Hospital, Chelsea, the husband of Mary Somerville, the mathematician and authoress, an explorer who is described as the first white man to visit the Orange River and a Fellow of the Royal Society; the celebrated George James Guthrie who was four times President of the Royal College of Surgeons; and Dr. Theodore Gordon who, with Dr. Gregory, drew up the first appeal and who was one of the earliest trustees. It may be noted that all the foregoing, including the Director-General, came from Aberdeen.

The principles laid down by the Committee and "unanimously approved by a very numerous meeting of Army Medical Officers held in Berkeley Street on June 15, 1820," have never been departed from. They are that, "The leading feature of this Fund is that it is benevolent. The objects of its bounty will be selected from among those who produce the strongest claims to its support. Where there is any equality of claim preference will be shown to the orphans whose parents contributed to the Fund. Orphans who have lost both father and mother will, if otherwise destitute, be considered to have a superior claim. Those whose mothers are living may, however, be admitted to its benefits provided the mother's income is inadequate to the education of the orphans. The circumstances of each case will be judged of annually, first, by a Committee, and afterwards by a General Annual Meeting who will ultimately select the cases proper for relief and specify the amount to be afforded to each. This will be regulated by the circumstances of each case and the extent of means of which the Fund may be possessed in each year. It is understood that relief by the Fund is always to be afforded in the form of periodical *donations* and never in that of an *annuity*, even for a limited number of years."

The report expressed the pious hope that "hereafter the opulent in the department will remember this Fund in their testamentary dispositions," and from time to time the Society has gratefully acknowledged the receipt of donations from this source.

At an early meeting of the Society a member, whose name is not given, raised the interesting question, "whether the regulations of the Fund could be so framed that the children of such medical officers as have families but no *wife*, might have a distinct claim for relief?" But the Committee would have none of it and decided that "such a proposition could not be entertained, it being incompatible with the other objects of the Fund."

The first Annual General Meeting was held at Berkeley Street on May 15, 1822, when it was announced that the donations and subscriptions received exceeded £1,000 (one thousand pounds) which had been invested in the Navy five per cents, afterwards transferred to the "New Fours."

The medical officers stationed at Sierra Leone contributed £40 (forty pounds), so apparently the staff at that health resort must have been considerably higher than at the present time, or perhaps the officers may have been in some doubt as to their return and wished to make provision for their families in good time.

It was decided that the capital should accumulate and that no grants should be made until it produced a "yearly permanent interest of £100 (one hundred pounds)."

The first distribution was made at the Annual General Meeting, Almack's Rooms, May 16, 1826, when £100 was voted for the assistance of fourteen orphans whose names, it was decided, "shall not appear in the printed report of the proceedings." This rule is in force at the present time, the recipients being described by the initials of the father.

In subsequent years, Sierra Leone again and Jamaica made very handsome contributions and received special letters of thanks from the Director-General. The officers in Canada were well to the fore, but India appears to have somewhat lagged behind and received gentle admonition in the reports.

So rapidly did the charity prosper that at the Annual Meeting at Willis's Rooms in May, 1828, £200 (two hundred pounds) were distributed among twenty-three orphans, and in 1833, £300 (three hundred pounds) among fifty-one orphans, and though the amounts allotted to each appear to be small it will be remembered that the purchasing power of money was probably four times as great as at the present day. A further indication of the relative value of money appears from the fact that the secretary, who had up to that time given his services gratuitously was granted a salary of £20 (twenty pounds) a year, and when the Rules were amended and reprinted in 1833 the cost of 1,000 copies was only £5 12s. 6d.

Reports of Committee meetings are proverbially dry reading but there is a touch of humour in the complaint of a staff surgeon in Canada that his subscription sent a year before had not been acknowledged. The reply of the Committee was that, "the letter having been forwarded with a packet of returns from Canada it unfortunately got mislaid among them upstairs and did not come into their hands until after Mr.——'s bankruptcy (on whom the bill for 11 guineas was drawn.") The Committee greatly regretted the circumstance and begged to leave it entirely to the Donor whether he would pay the amount or not. There is no further reference to the matter in the minutes, so it seems probable that the Society never got the cash. The occurrence seems to indicate that the weekly sick returns were not at that time so punctually examined and returned for amendment with that unfailing regularity which some of us remember in our early days.

In 1840 the amount distributed rose to £400 and remained with small fluctuation at or about that sum for twenty years, not reaching the £500 (five hundred pounds) level until 1860.

In 1843, Messrs. Stoddart and McGrigor (afterwards Sir C. R. McGrigor, Bt., and Co.), were appointed bankers of the Fund, and they have kindly presided over its finances ever since and given all possible assistance. Sir James McGrigor has been one of the Trustees for many years.

In this year the limit of age for which orphans are eligible for assistance was fixed at twenty-one years, "except in special cases to be decided by the Committee." This covers many sad cases where the children from mental or bodily infirmity are unable to earn their own living.

For some years the orphans of purveyors and purveyors' clerks were admitted to the benefits of the Fund, and Mr. Joseph Harrington, a purveyor, was President on more than one occasion and afterwards a Trustee.

The Committee meeting held on July 22, 1843, apparently produced some rather warm discussions—one of the members sharply criticising several points in the administration of the Society; but at the meeting held on September 2 (at which this

critical member was not present), it was decided that the sheet recording what were described as "desultory remarks" should be removed from the Minute Book. This was done and the secretary noted the decision on the neatly-cut fragment that remains, so we are left in doubt as to the nature of the "desultory remarks" referred to.

In 1850 there is an interesting entry of a grant of £95 (ninety-five pounds) to a widow and six children to enable her to emigrate to "South Carolina, New York, America." She travelled by *steamer* and the Captain of the ship received £44 (forty-four pounds) for passage money. Apparently this did not include food as the widow was granted £5 (five pounds) for provisions.

The attendances at Committee meetings were often scanty and there are several entries showing that a quorum was not obtained. Even the General Annual Meetings which were usually held at the "Thatched House Tavern, St. James' Street," failed to attract the members, but in 1852 there was a good attendance "and the company adjourned to Sir James McGrigor's, Harley Street, to partake of a cold collation." Possibly there was some connexion between the two events.

Income (or property) Tax appears about the same time and steps were immediately taken, ultimately successfully, to recover it on behalf of the Society. The rate was apparently 7d. in the £. What a pity we did not live in those days?

In 1858 Sir James McGrigor died. He had been the founder of the Society and many times its President. His interest in the Society never ceased and his name occurs repeatedly as attending meetings sometimes in the subordinate capacity of vice-president or ordinary member. He made many handsome donations besides his annual subscriptions during his life, and left a legacy of 100 guineas in his will.

Sir Charles Mansfield Clarke also died in the same year and left £500 (five hundred pounds) to the Society.

In 1868 the amount distributed rose to £600 and in 1872 to £700, but it must be admitted that by far the larger portion came from the interest on capital, invested at that time in Consols, amounting to nearly £17,000 (seventeen thousand pounds) which produced £500 a year. The annual subscriptions did not exceed £150 (one hundred and fifty pounds), aud appear from the statements of accounts to have gradually dwindled to a little over £100 a year.

Dr. Ligertwood, whose services in connexion with the Fund will always be remembered, first appears as a member of Committee in 1870. He never missed a meeting, and in 1875 was unanimously elected as Secretary on the retirement of Deputy Inspector-General H. Pilleau, who was compelled to resign on account of ill-health.

Dr. Ligertwood occupied the post of Secretary for over thirty years, when he was succeeded, in December, 1906, by the late Lieutenant-Colonel F. W. Davie Harris.

In 1872 the greater portion of the Consols were sold, and £14,000 invested in Railway four per cent Debenture Stocks, at that time standing at or above par. Present holders of these stocks will read this announcement with regret.

In the closing years of the last century the Society appears to have fallen on somewhat evil days. The Annual Meetings were badly attended, often only five or six members being present; and, though the interest from investments per-

mitted of the distribution of £500 to £700 annually, the subscriptions and donations showed a lamentable diminution.

In 1893 a note was attached to the Annual Report containing the accounts, that "the donations from officers amount to £78, i.e., about one-tenth of the total sum distributed annually, and that even of this minute sum about five-sixths is derived from officers retired from the Service, whose orphans are not likely to derive much benefit from the Fund, while the great mass of those who receive assistance are orphans of officers on the active list. Thus, while the importance of assisting in the education and first start in life of the orphans is undoubted, the Society does not receive that support from Medical Officers on the active list which it so urgently needs." This note was repeated in the Annual Statements for several years without producing much effect, but it seems probable that this was not due so much to the lack of charitable instincts on the part of officers serving on the active list as to the fact that the Society was not prominently brought to their notice. The Annual Reports were only issued to officers who were already subscribers, and there does not seem to have been any definite effort to reach the younger officers individually until 1902, when a special appeal was made to the whole of the members of the R.A.M.C. for subscriptions to the Fund. This produced £100 (one hundred pounds), and the number of subscribers steadily though slowly increased. The institution of the Journal and publication of the accounts and meetings in the Corps News, which commenced in 1906, also undoubtedly aided in bringing the Fund to the notice of officers.

During the late war, owing to the large number of casualties among junior officers, often leaving families of young children, it was decided by the Committee to make a special appeal to the Corps, and a letter was sent to every officer on the active list who was not a subscriber, as well as to each officer on receiving a permanent commission, with the result that the number of subscribers, which had never previously reached 200, rose to 300 in the year 1918, and to over 400 last year. It is believed that this figure will be largely exceeded during the present year.

Donations were also received from individual officers and from the officers' messes of certain general and other hospitals on closing their accounts.

In consequence of this generous support, the annual grants to orphans, which had previously fluctuated between £600 and £700, were raised by the General Meetings in 1917 to £755 and in 1918 to £850, and last year to £1,300.

The value of this assistance to widows in the education of their children can hardly be over-estimated, nor should the cases be forgotten of poor women, daughters of former officers of the Corps, who have been left unprovided for, and who are unable on account of permanent ill-health to earn their own livelihood.

It is earnestly to be hoped that the amounts available for distribution may never fall again to their former level, especially when the increased cost of living and diminished purchasing power of money is taken into consideration.

The Charity appeals to all officers of the (Regular) Royal Army Medical Corps, past and present, and it may be noted that it is the only Corps Fund from which assistance can be rendered, as the R.A.M.C. Fund (Officers' Branch) deals only with the band, dinner and memorials, and the General Relief Branch, which is supported mainly by donations from regimental institutions, is for dependents of warrant officers, non-commissioned officers and men.

At the Annual Meeting in 1912 it was decided by a unanimous vote that the orphans of quartermasters should be admitted to the same benefits as the children of other officers, and at the Annual Meeting last year the maximum grant issuable to any family in any one year was raised from £40 to £60.

The Secretary will be very pleased to forward books of the rules and any further information to intending subscribers.

A CLINICAL METHOD OF DETERMINING THE TYPE OF THE INFECTING MENINGOCOCCUS IN CASES OF CEREBROSPINAL MENINGITIS.

By Major A. S. GORDON BELL.
Royal Army Medical Corps.
Of the Central Cerebrospinal Fever Laboratory.

If the standard method of agglutination at 55° C. be employed seventy-two hours generally elapse between the lumbar puncture and the type being determined.

With the rapid method herein described, twenty to twenty-four hours only are needed to type; homologous curative serum can then be given. The advantage is obvious.

Technique.

Use a pipette made from glass tubing, drawn to a *very* fine point and fitted with a teat. On a glass plate drop one drop of each of the four type sera; alongside each of these drop an equal volume of the emulsion of the coccus under examination; this should be 40,000 millions to 50,000 millions per cubic centimetre. Mix and examine the four pools with a watchmaker's glass. Type is indicated by the pool in which agglutination *first* appears.

(*a*) After five minutes if a negative result obtain, arrange the serum on the plate thus:—

Type I		Type II		Type III		Type IV
2 drops	..	2 drops	..	2 drops	..	2 drops
3 ,,	..	3 ,,	..	3 ,,	..	3 ,,
4 ,,	..	4 ,,	..	4 ,,	..	4 ,,

To each of these pools of serum add a drop of emulsion, mix and examine as before.

(*b*) If the result is not specific, i.e. agglutination appears in two pools within two minutes of each other, vary the *emulsion* thus:—

3 drops	..	3 drops	..	3 drops	..	3 drops
6 ,,	..	6 ,,	..	6 ,,	..	6 ,,
12 ,,	..	12 ,,	..	12 ,,	..	12 ,,

To each of these add one drop of Type I serum in the first vertical row, one drop of Type II in the second row and so on. Mix and examine as before. Agglutination will no longer appear with the heterologous serum. If there is agglutination with both I and III and a specific reading cannot be obtained, the type may be called provisionally I, as the Type I serum, so far as I know, is specific.

(*c*) If there is not sufficient growth to allow of a 40,000 million emulsion, take

a few drops of saline, pick off colonies and make an emulsion. Now instead of a pipette use a platinum loop to make the several mixtures.

General Rules.

(1) If the coccus has been grown on blood, get rid of as much as possible of this before making the emulsion.

(2) Always kill the coccus at 65° C. before testing.

(3) In the end agglutination will generally appear with all four type sera and even with the normal serum. This agglutination may be disregarded. Again, if by varying the emulsion specificity cannot be obtained, and at least one minute does not elapse between the agglutination by two sera of different types, the result should be disregarded and the patient treated with pooled serum till the type can be determined by the usual slow method.

(4) Always confirm results by the slow method at 55° C.

Results of Laboratory Tests.

With fifteen laboratory specimens of Type I :—

Correct answers		Negative		Incorrect
13	..	1	..	1

With twenty-five laboratory specimens of Type II :—

Correct answers		Negative		Incorrect
24	..	1	..	—

With twelve laboratory specimens of Type III :—

Correct answers		Negative		Incorrect
12	..	—	..	—

With seven laboratory specimens of Type IV :—

Correct answers		Negative		Incorrect
4	..	3	..	—

As Type IV is so relatively rare this is of small moment.

With fourteen recent cases of cerebrospinal fever a correct answer, as subsequently confirmed by the slow method, has been given in twelve; one was negative and one wrong.

All these results were obtained in under twenty-four hours after lumbar puncture.

This method is at present of no use in typing cocci obtained from post-nasal swabs, as agglutination has been known to take place with Gram-negative naso-pharyngeal cocci which do not absorb and therefore are not true meningococci.

Too much weight must not be laid on the results obtained with laboratory specimens, as experience has shown that meningococci under prolonged culture on egg and trypagar media may tend to become more specialized than when recently isolated.

The general correctness of the results obtained with actual cases indicates that this method should be tried in view of the simplicity of the technique. Any medical man with sufficient skill to add blood aseptically to a slope and possessed of a 37° C. incubator can grow the meningococcus; the putting up of

dilutions of varying strength and the need of a 55° C. incubator are dispensed with.

The opinions expressed in the Medical Research Committee's recent pamphlet "The Specific Treatment of Cerebrospinal Fever, with an Analysis of the Reports on the first Ninety Cases treated with Monotypical Sera" emphasize the necessity of early typing and the use of monovalent sera. "Although the aggregate of cases is not large, a considerable proportion of them were severe—some very severe—and the positive evidence which they afford of the therapeutic value of monotypical serum is, therefore, of considerable weight" (M. H. Gordon).

Final deduction from the same pamphlet: "The great importance of promptly determining the type of meningococcus and of using the appropriate serum at the earliest moment" (T. G. M. Hine).

A titre of 1 : 2,000 is desirable to start with.

It is necessary to get rid of the group agglutinins which are always present with sera of this strength. These group agglutinins are eliminated by saturating them with cocci of the heterologous types.

Technique.

100,000 million cocci of each heterologous type, killed by heating to 65° C., are added per cubic centimetre of the serum under treatment. Details as follows:—

Grow a large number of plates, wash off in a few cubic centimetres of saline solution. Kill at 65° C., phenolate, centrifuge for two hours, decant the supernatant fluid, add the serum to the solid cocci remaining. Stir up, put in a bottle, shake well, incubate for two hours at 37° C., repeating the shaking three times during this period. Re-spin till the serum is clear, decant and test against a large number of emulsions of homologous and heterologous cocci for catholicity with regard to the former and specificity with regard to the latter. If specificity is not present, repeat the process of saturation.

Reviews.

Swanzy's Handbook of the Diseases of the Eye and their Treatment. By Louis Werner. London, 1919: H. K. Lewis and Co., Ltd. Pp. xviii and 671. Price 22s. 6d. net.

The twelfth edition of this standard work on ophthalmology has been most carefully revised and is thoroughly up to date, and the new matter introduced greatly increases its scope and value. We can strongly recommend this book to all those taking up the study and practice of ophthalmology.

The chapter dealing with the surgery of penetrating wounds of the eye with retained foreign bodies is of special interest to military ophthalmic surgeons and is well written, but we do not think that in describing the operative treatment the importance of not losing the aqueous when making the corneal section is sufficiently emphasized and we note that it is recommended that a Greafe knife be used for making the Corneal Section, we consider the straight Keratome a better instrument, the risk then of losing the aqueous is almost nil, owing to the valve-like corneal made. The Keratome was universally used for this purpose by ophthalmic surgeons in France during the war.

With regard to the statement that it is best to remove all magnetizable F.B.'s through the A.C. We think the posterior route is the better method when there is a visible wound of the sclerotic, and where the F.B. is of large size, when it will not come forward. J. H. G.

MUSINGS OF AN IDLE MAN. By Colonel Sir R. H. Firth, K.B.E., C.B., F.R.C.S. London, 1919: John Bale, Sons and Danielsson, Ltd. Pp. xii and 359. Price 7s. 6d. net.

In this book the author has given us a series of pictures—in some cases microphotographs—of the workings of his mind. The apology for the work, if such is needed, is best given in his own words in his "Musing" on "Survival of Virtues." "The pragmatic reader may say I am a dreamer and writing metaphysical nonsense. It may be or it may not be so. I write my thoughts as they come, for better or for worse, and recognizing that it is as well to contemplate invisible things seriously, and as though we see them with our eyes."

Books such as this are always interesting for the insight they give us into the personality of the writer rather than for the opinions recorded. "Musings of an Idle Man" should be read in this spirit. It is not one to read laboriously at a sitting, but rather as it was written, at odd intervals. It is a good book to have in the pocket on a walking tour or a railway journey.

The range of subjects is wide, from the connotation of everyday expressions to the ultimate constitution of matter. As is inevitable with such a scope, the treatment of subjects differs very much. Some are distinctly laboured, for example, "On Habits," "On Donkeys." These, however, are amply compensated by others, such as "The Survival of Virtues," "Lest we Forget," "Mysticism." Through all the scientist is struggling with the mystic, and one cannot help feeling that the deepest sympathies of the author are with the latter rather than with the former.

Many of the musings appeared in this journal, and to many were and still will be welcome correctives to the material conception of the science and art of medicine which seeks to solve all problems by means of the test tube and microscope. W. R. G.

MALARIA IN MACEDONIA. By P. Armand-Delille, G. Paixeau, P. Abrami, Henri Lemaire. Preface by Professor Laveran. Translated by J. D. Rolleston and edited with a preface by Sir Ronald Ross, K.C.B. University of London Press, Ltd. 1918. Pp. xii and 115. Price 6s. net.

In this manual four French writers record their clinical experiences, observations and the results of treatment of malarial fevers as manifested in the troops engaged in the recent Macedonian Campaign.

The authors present their case with expressive clearness; the style is clear, terse and dogmatic. They do not claim the work to be in any sense a monograph. We would at the outset state that the book will be of very considerable interest and value to those who have to treat malaria not only in Macedonia but in other places and we would specially commend it to those medical officers proceeding to India in charge of the new Army, but we should add that its value will be much enhanced if the reader has previously familiarized himself with descriptions of the disease and its pathology in the larger text-books of tropical diseases, such as Castellani and Chalmers's or Manson's. The descriptions and opinions expressed in the manual should then be examined critically in the light of the reader's own experiences.

Briefly the points of the authors' thesis are these:—

(1) That while the clinical manifestations of malarial fevers are due to the

activities of the three forms of parasites, it is impossible, or does not serve any useful purpose, to differentiate clinically the symptoms produced by each.

(2) That the cause of all recrudescence of malaria in the individual is the asexual form, and its spread to others is the gametocyte or sexual form, the former occurring by parthenogenesis of the gametocyte in the individual with the production of a new generation of merozoites, the latter of course by ingestion by the mosquito and subsequent developement.

(3) That only the asexual forms of the parasites are susceptible of destruction by quinine, the sexual forms remaining unscathed.

(4) That the only hope of a "cure" in malaria is to attack and kill off the asexual forms in the very first period of infection before the production of gametes has commenced, i.e., from the eighth to the tenth day of the disease.

With the formation of gametes, hope of cure is lost, the patient becomes a case of chronic malaria, liable at any time to an outburst of malaria fever from parthenogenesis of gametes.

(5) That therapeutic efforts therefore should be concentrated against the parasite in the primary stage of invasion by the parasite, quinine in large doses being administered to kill off the asexual forms before they have had time to produce gamete forms.

(6) That since quinine is efficacious in killing only the asexual forms, it is of no use continuing its administration during afebrile periods, and further, since real relapses in the individual are the result of parthenogenesis of the gamete, quinine is useless as a prophylactic against relapses in an infected individual; in fact, by its deleterious influence on metabolism and digestive function, it is actually harmful in doses considered necessary as a prophylactic against relapse.

The greater part of the book consists of a description of the clinical manifestations of malarial fever as observed by the authors. The various syndromes are clearly and carefully described in detail, but no clear indication is given of the relative general or seasonal frequency of any particular syndrome, or the association with a particular form of the parasite.

We think these regrettable omissions. The authors state that the quartan parasite was practically absent throughout, that more than eighty-five per cent of the cases of malaria during the season July to November were caused by the *Plasmodium falciparum*, the agent of malignant tertian; while the *P. vivax*, the agent of benign tertian, is rare in summer, occurring in only fifteen to seventeen per cent of the cases, but becomes very predominant from December to July. It is probable that certain syndromes predominated during these seasons, due to the prevalence of one or other parasite, and we consider it would have added much to the value of the book had an indication been given not only of which syndrome predominated seasonally but also of the comparative frequency with which the various groups of syndromes occurred, and in conjunction with which form of parasite.

Little or no reference is made to the pathology of the various syndromes. We think this is a pity as in our opinion the pathology explains many of the protean syndromes. The immediate symptoms of a malarial attack are due to two distinct causes, firstly, the action of a pyrogenetic toxin liberated by the parasite in sporulation; secondly, the mechanical action, the red cells being so affected by the contained parasites that they adhere to the capillary walls, producing blockage of the capillaries. This fact is not very clearly brought out in the book. These two factors acting conjointly produce intense local effect by blockage of the capillaries and by the concentrated local action of the toxin—in the brain causing coma and paralysis—in the gastric organs causing dysenteric, choleraic and gastro-hepatic symptoms in the pancreas, hæmorrhagic pancreatitis, and in the suprarenal giving rise to a "Syndrome of Acute and Subacute Renal Insufficiency" or "Malarial Pseudo-Addison's Disease."

As stated, the larger part of the book is taken up by descriptions of clinical manifestations. The authors divide the disease into two distinct periods "Primary and Secondary Paludism." They rightly insist that at the onset all these types of fever may be irregular, but we doubt if clinicians in India will admit that they are always so to the extent stated in the book, though we must remember that it is only the malarial fevers in fresh infected troops in Macedonia that are being described.

We moreover certainly agree that in our text-books too much description is lavished on the "malarial rigor" or "well desciplined" attack occurring at regular intervals, which is a later manifestation of the disease. The irregular fevers are due to the fact that the parasites are of different ages, due to different times of inoculation. That later the attacks settle down to a regular type is possibly due to the amount of antitoxin generated by the individual being able to kill off those parasites which do not conform to the age period of the majority.

A multiplicity of inoculations would mean a long period of irregular febrile attacks, i.e., primary paludism, and the more the individual reacted to the parasite by the production of antitoxin, the sooner would the attacks settle down to a regular type, and enter the period of "secondary paludism."

The authors adopt the "*parthenogenetic*" theory of relapses. Ross and Thompson by their enumerative methods deduced that relapses are due to small numbers of asexual forms present taking on a sudden activity, due to some lowering of the vitality of the individual.

The importance of a four-hourly temperature chart is insisted on; such a chart may reveal pyrexia and periodicity of great diagnostic value.

We would commend a careful reading of the clinical descriptions to all military officers dealing with malarial outbreaks. Accurate clinical observations will lead to a much better knowledge of the disease than many blood examinations.

The treatment advocated is sound, though many will not agree with the withholding of quinine during apyrexial period between relapses, especially if they do not accept the parthenogenesis theory. Intramuscular or subcutaneous injections of quinine in dilute solutions and properly sterilized are recommended as the best treatment during primary invasion.

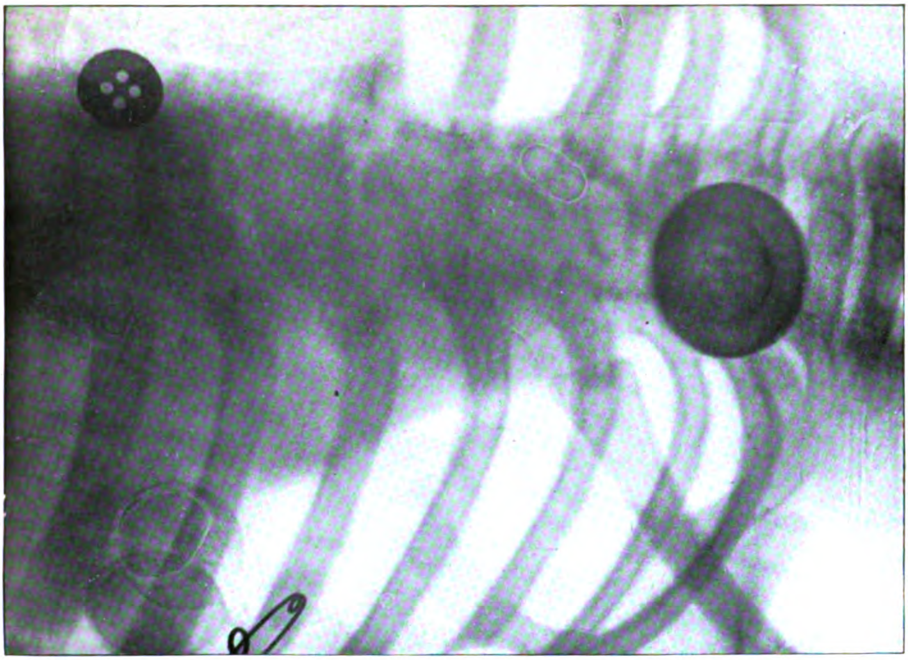
Subcutaneous injections have somewhat fallen into disrepute, probably mainly through faulty technique, but there are some practitioners in India who strongly recommend them, given in the manner here described.

The war produced many new problems in medicine and surgery, many of which were successfully solved; the question of whether quinine is efficacious as a prophylactic against a fresh attack or a relapse of malaria is one that we cannot claim to have settled.

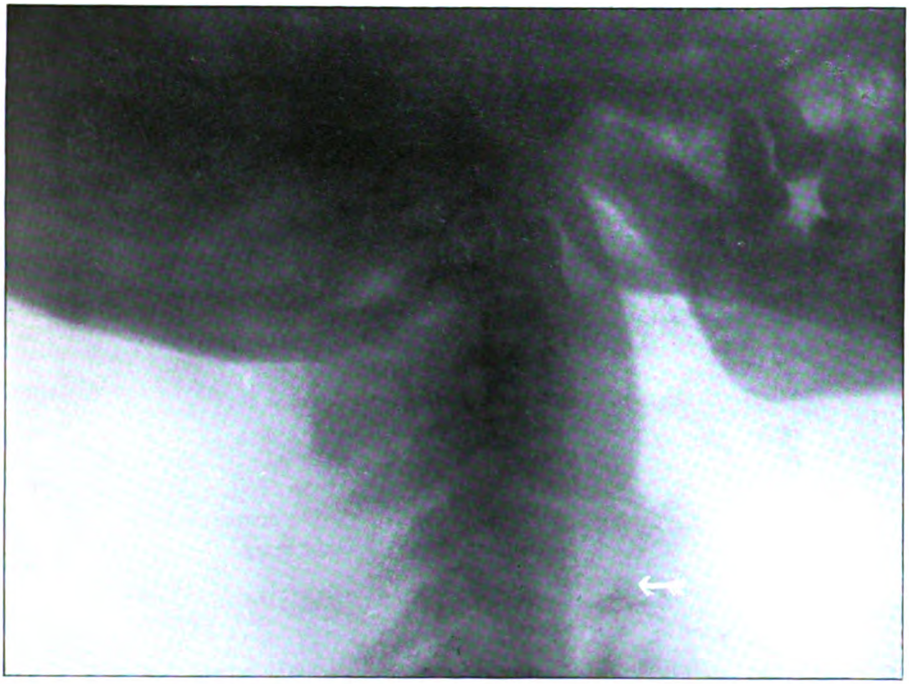
This being a military handbook we should have expected to hear more of the authors' views and experiences on malaria prevention in Macedonia and of the measure of success which attended the sanitarians' efforts. The authors affirm that quinine is of no use in preventing relapses and should not be given in apyrexial intervals. They are of opinion that prolonged use of quinine in doses of one gramme and above presents real dangers, but in a later paragraph they state that "in these rare cases where the mechanical prevention provided by the mosquito net is not available, it is obvious that between the relapses the malarial subject should obey the rule of preventative quinine treatment (0·5 to 0·75 grains of quinine per day)."

There seems then to have been a general issue of prophylactic quinine aud we should have liked to have had the authors' views on its efficacy, and whether more of the "real dangers" mentioned earlier, viz., anorexia and digestive disturbances, occurred. It would seem that the "cult of the mosquito net" is still the only certain prophylactic.

During 1918 experiments on the British garrison in India were carried out on a large scale aud the results are awaited with interest.



CASE 1



CASE 2.

To illustrate "Two Successful Cases of Cervical Œsophagotomy for Removal of Foreign Body," by Captain LEIGH DAY, R.A.M.C.

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Original Communications.

NOTES AND COMMENTS UPON MY MALARIA EXPERIENCES WHILE WITH THE EGYPTIAN EXPEDITIONARY FORCE, 1916-1918.

BY H. M. WOODCOCK, D.Sc.LOND.
Fellow of University College (Acting Head of the University Department of Protozoology).

WHILE on service with the Egyptian Expeditionary Force during the years 1916 to 1918, I was stationed at one time or another in the chief districts in which malaria occurred in Egypt and South Palestine. Although necessarily incomplete, because no total statistics can be given, it is hoped that these notes may be of interest, as affording an indication of the relative frequency of occurrence of the different types and their seasonal variations in different localities during the above period. The opportunity is taken of discussing the question of seasonal prevalence; and some remarks are added with regard to the chief factors, as it seems to me, which affect the severity of malignant attacks, and also upon the treatment adopted for such attacks in the hospitals to which I happened to be attached.

(1) RELATIVE FREQUENCY OF OCCURRENCE; SEASONAL VARIATIONS.

In Egypt, during 1916, the only area where malaria was at all prevalent was in the Southern Canal Zone, from south of Ismailia to Suez. I was then stationed at the Military Laboratory at Port Tewfik, where the examinations for a large part of this area were made, including the posts in the neighbourhood of Geneffa, Shallufa, Kubri, El Shatt and Ayun Musa (Moses' Wells). These posts were variously held by British or Indian troops.

Until July there was practically no malaria. A few cases occurred towards the end of that month, and thence onwards, until the end of November, there was a steady influx of cases, though the number at any one time never became great. September and October were the worst months. During the four months August to November inclusive, 178 British cases were diagnosed, of which 112, or 63 per cent, were benign tertian, and 66, or 37 per cent, were malignant tertian. The proportion of benign to malignant was thus nearly as 2 to 1. There was no relative increase of the malignant type during the later autumn months; in fact, during October and November the proportion of benign was higher than during the earlier months. Amongst Indian troops, 192 cases were diagnosed,[1] of which 20 per cent only were benign tertian, 80 per cent being malignant, the proportion being as 1 to 4. The reason for this great difference in the relative proportion of the two types amongst British and Indians respectively was most probably because many of the latter (who were mainly recent arrivals from India) were already infected with malignant tertian. This view is borne out by the fact that crescents were found not infrequently in the Indian cases, whereas they were not seen on any occasion amongst the British, the latter being all fresh infections.

Only two cases of quartan fever were observed. Both these occurred in Indians and I do not think they were acquired in the locality.

During December and the beginning of January there were a few odd cases, but after the turn of the year the incidence of malaria for that season had practically ceased.

In 1917, whilst the troops were in Sinai and on the Gaza front, there was no malaria. I was stationed at the Military Laboratory, Kantara, from the beginning of August onwards. All the sick coming down the line to Egypt passed through the hospitals there, which were served by this laboratory. Until late in October, I have no note of a single case being recorded. It was only after our advance into Palestine began, at the end of October, that malaria developed. During the two months, November and December, Captain Stuart and myself diagnosed 231 British cases, 143, or 62 per cent, of them being benign, and 88, or 38 per cent, malignant tertian. A certain proportion of these particularly, though not exclusively, of the benign cases, were in all probability relapses, the men being known to have acquired malaria in Macedonia or Taranto. Unfortunately the numerical ratio of these relapses to the total number was not noted, but according to my recollection it would be about twenty to twenty-five per cent of the benign tertian infections. No cases of quartan occurred.

Our laboratory was moved up to Jaffa in February, 1918. There had

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[1] This figure includes a few cases amongst men of the Egyptian Labour Corps; these were not noted separately, but the number did not, I think, exceed four or five per cent.

been several cases of malignant tertian in this neighbourhood during January, but by the time I arrived the season was coming to an end. During the three weeks in February and the whole of March, out of nearly 1,500 examinations made, only 23, or 1·5 per cent, were malignant tertian. On the other hand, there were 169 cases of benign tertian. The proportion of benign to malignant was thus very high, viz., 87 per cent to 13 per cent, but the majority of these benign cases were recurrences or relapses.

During April, May, and the early part of June there was scarcely any malaria amongst the troops north and north-east of Jaffa, but by the end of June the new season had commenced. The line in the coastal sector was now held by Indian divisions, consisting of mixed British and Indian troops who had not been in Palestine during the preceding malaria season, and the great majority of the cases occurring at this time, at any rate in the British battalions, were new infections. During July, 251 British cases were diagnosed, of which 207, or 82 per cent, were benign, and 44, or 18 per cent, malignant tertian. Amongst the Indian troops the proportions were fairly similar, there being 106 cases, of which 81 (76 per cent) were benign, and 25 (24 per cent) malignant.

At the beginning of August I was transferred to No. 3 Military Laboratory, Jerusalem, owing to the pressure of the work there. During the two months August and September, 1,134 cases of malaria were diagnosed at that laboratory by Captains Gunn and Anderson and myself, out of over 8,300 examinations made.[1] Unfortunately, owing to the amount of clerical work involved, distinction was not made between British (including Australian) and Indian cases, and the totals were not separately recorded. But the former would be, I think, from fifty to sixty per cent of the total. For this period the proportion of benign to malignant tertian was 65·4 per cent to 33·9 per cent. In addition, eleven cases of quartan fever were recorded, i.e., almost one per cent of the positives: these occurred amongst British as well as Indians. There is evidently a small focus of quartan malaria in that district, the only one which came under my notice during the time I was with the Egyptian Expeditionary Force. Nearly all of these cases, also, were new infections, and it is interesting to note that the ratio of benign to malignant during this period was almost as two to one, the same proportion as found amongst the British troops in Egypt two years before.

After our advance northwards, however, the proportion between the two types changed remarkably. The advance began on September 19, and during the two weeks from September 29 to October 12, we diagnosed 978 cases of malaria out of 2,460 examinations, and of these no fewer than 842,

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[1] The reason for the much greater number of cases (of pyrexias of all kinds) dealt with at Jerusalem is that the sick from a larger sector of the line passed through the three casualty clearing stations there than through the one at Jaffa.

or 86 per cent, were malignant tertian, while only 134 (13·7 per cent) were benign. As a similar state of affairs existed at the other two chief laboratories (at Ludd and Jaffa) as well, not to mention several malarial "diagnostic stations," the amount of dangerous malaria with which the

COMPARATIVE DIAGRAM OF NUMBERS OF MALARIAL CASES DIAGNOSED DURING VARIOUS MONTHLY PERIODS, 1916-1918.

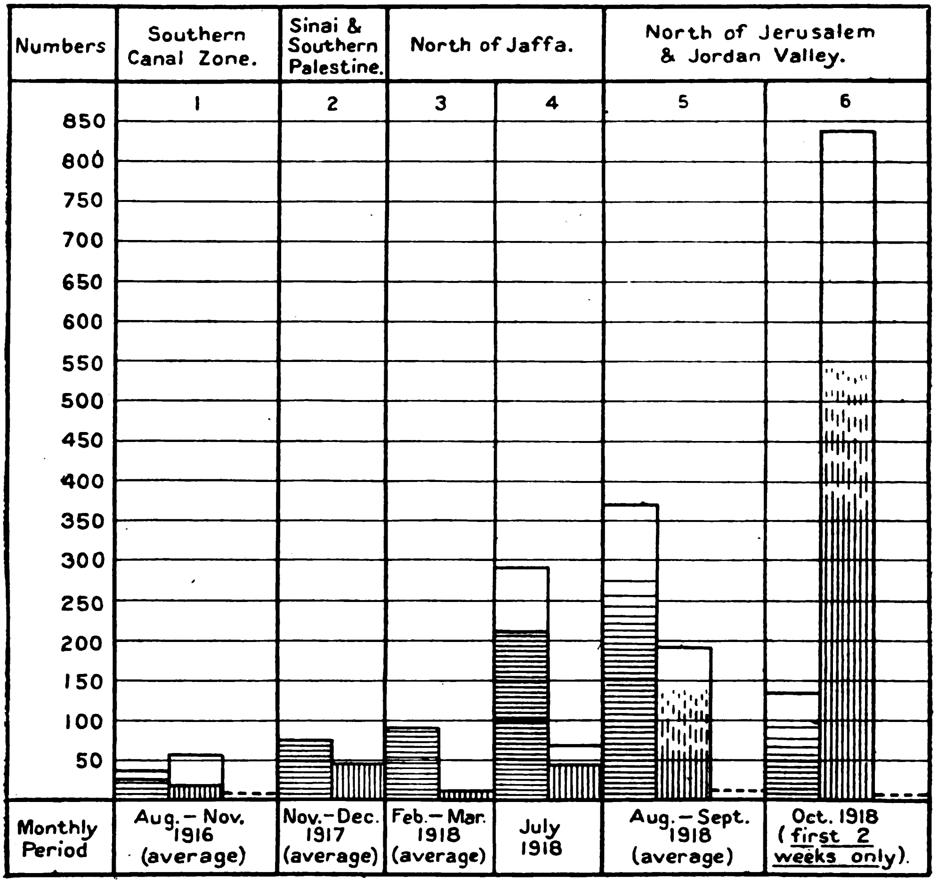


FIG. 1.

Explanation of Fig. 1.—Benign tertian = ; malignant tertian = ; quartan = ... (this last was minimal and is only indicated to show where it was met with). The upper, unshaded part of a column represents Indian cases. In columns 5 and 6 the shading is spaced out, because the exact proportion of Indian to British cases was not determined. For columns 2 and 3 there were no Indian cases.

medical service was suddenly overwhelmed can be imagined. These were the two worst weeks, at any rate as regards the laboratory at Jerusalem. By this time the bulk of the troops had moved far to the northwards, and I myself was shortly afterwards transferred to Cairo, to serve on a commission there, so had no further opportunity of making observations.

In the accompanying figures (1 and 2) the chief facts I have outlined are indicated in the form of comparative diagrams. From these it will be seen that the seasonal prevalence of the two chief types occurring in South Palestine varied at different periods. Benign tertian is the commoner form in summer. During 1918 it was at its height, both as regards the

COMPARATIVE DIAGRAM OF PERCENTAGE OF MALARIA AMONGST TOTAL CASES OF PYREXIA EXAMINED DURING VARIOUS PERIODS, 1916-1918.

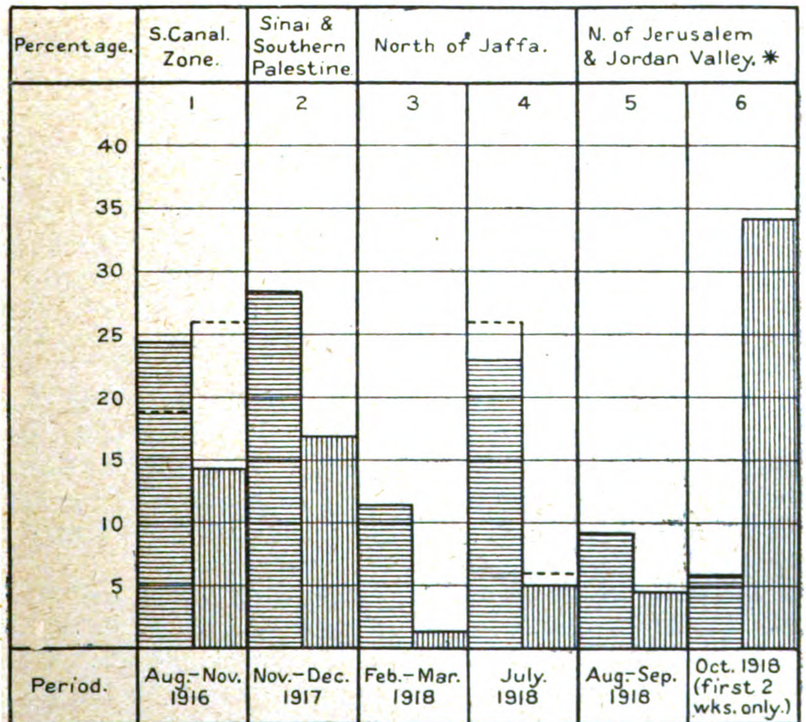


FIG. 2.

Explanation of Fig. 2.—Benign tertian = ; malignant tertian = ; quartan is omitted, the percentage being too small to represent. The dotted line in columns 1 and 4 represents the total percentage when Indian cases are added. Columns 5 and 6 show only the combined total (British + Indians).

* While at Jerusalem, several repeat examinations were made (not separated in the records), so that the actual proportions were uniformly slightly higher.

percentage of cases and in its proportion to malignant tertian, during the month of July (fig. 2). In autumn, on the other hand, the malignant tertian type predominates markedly. The sudden reversal, and to such an extent, of the relative proportions of the two types about the end of September was indeed surprising. Although the proportions given in column 5 are the monthly average for the two months, there was nothing

in the weekly numbers to indicate that this great change was impending. Throughout August and nearly all September, the number of benign cases was invariably higher, and usually considerably so, than that of the malignant tertian ones. It is important to note that, according to the existing malaria charts in the laboratory at Jerusalem (which was formerly the German "International" Hygienic Bureau), the incidence of malignant tertian was known to be highest towards the end of September and the first half of October; the malignant curve rose very steeply and to a great height, falling later almost as sharply.

It was peculiarly unfortunate that our advance just coincided with this particular period. But it may be doubted if the advance was *per se* by any means altogether responsible for the enormous increase in the number of malignant tertian cases. Even had the troops remained on their old line during this time, it is almost certain, I consider, that there would have been a very considerable increase in the number, relative as well as absolute, of cases of malignant tertian (though probably not so great as actually occurred), because malaria *had* been occurring amongst the troops all the time; and in spite of the advance, it is important to note, both the percentage and the total number of benign tertian cases were distinctly *lower* than they had been previously.

Another point to notice is that malignant tertian infectivity dies down sooner than is the case in regard to benign. By the end of January, the percentage of the former is almost a minimum. Even allowing for the fact that a considerable number of the benign tertian cases during February and March (*vide* column 3 in both figs.) were relapses, there were, nevertheless, more fresh cases of benign than of malignant.

The Difference in the Seasonal Prevalence of Benign and Malignant Tertian.—The above comparison reveals one or two points of interest bearing upon the periods of infectivity in regard to malaria. What was the reason, for instance, of the sudden great increase in the malignant tertian infectivity of the particular species of *Anopheles* concerned, during mid-autumn? Fresh cases of malignant tertian had been occurring through the summer. This type started at about the same time as benign tertian, but its proportion remained low right through the summer and early autumn; that is to say, the mosquitoes are infective in regard to malignant tertian during this period; but to nothing like the extent they become—and, normally, it is to be remembered (from the existing charts)—in the autumn. Benign tertian infectivity, on the other hand, was highest during July, after which it decreased, and its proportion remained practically unchanged during the time of the rise in the percentage of malignant (cf. chart, fig. 3). Why this marked difference between the chief periods of infectivity in the two cases?

Celli (1904) gave very instructive curves of the seasonal prevalence of benign and malignant tertian in different regions of Italy; from these it is seen clearly that, *when recurrences and relapses ("Recidive") are separated*

from new infections, the main period of infectivity, *both for benign and malignant*, is in July and early August, and closely coincides for both types, in all parts of Italy. That is to say, the main period occurs shortly after the regular summer weather has set in, and mosquitoes are numerous.

CHART SHOWING THE CHIEF PERIODS OF INFECTIVITY OF BENIGN AND MALIGNANT TERTIAN AMONGST THE TROOPS IN PALESTINE, DURING 1918.

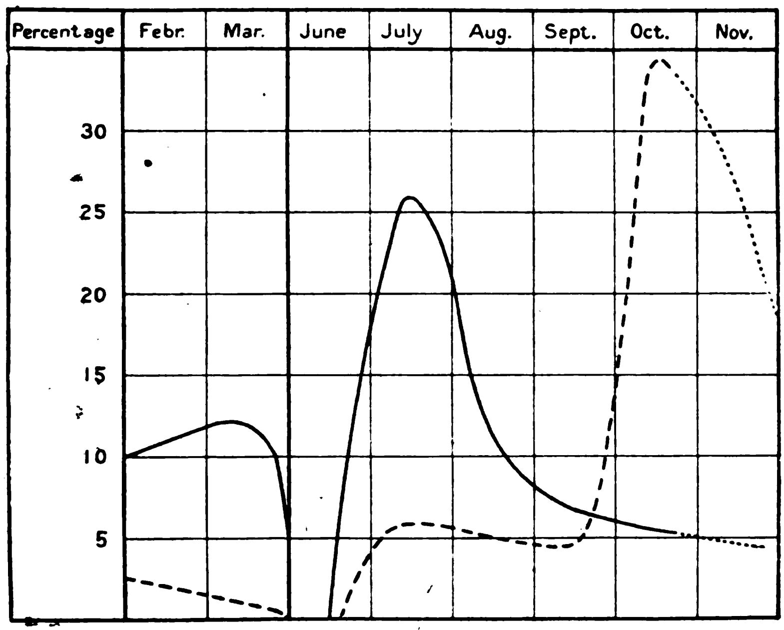


FIG. 3.—B. T. = ————; M. T. = - - - -. (The probable continuation of the curves, after October, is shown by a dotted line.)

But there are, on the other hand, known malarial districts where this coincidence does not occur; of these, South Palestine certainly appears to be one and Macedonia another (according to the illustrative diagrams recently given by Armand-Delille, Paisseau and Lemaire, *Bull. Soc. Path. exot.* 10, 1917, p. 284). I have constructed a chart (fig. 4) based upon the diagrams given by these authors, and the correspondence between their findings as to the chief periods of infectivity amongst the French troops in Macedonia and my own, relative to the same amongst the British troops in South Palestine, is seen to be remarkably close. In both, the chief incidence of malignant tertian (i.e., of new infections) is delayed for about three months after that of benign; quite unlike what is the case in Italy, both North and South.

As Ziemann says (translating from Mense, "Handbuch der Tropenkrankheiten"): "Since the optimum temperature for the development in the mosquitoes is, according to Jancso, not very different in the two types, it

might reasonably be supposed that new infections of both would appear about the same time." Hence (he continues) it is very remarkable that in some districts the type of malaria [meaning new infections] occurring earlier in the year is benign, while that occurring later in the season is malignant. Jancso sees the explanation in a special peculiarity of the different species of parasite, comparing their behaviour with that of plants, some of which flower in spring, others in summer, and others again in autumn. The only comment Ziemann has to make is that future years may be expected to throw further light upon this interesting subject.

CHART, CONSTRUCTED FROM DIAGRAMS GIVEN BY ARMAND-DELILLE, PAISSEAU AND LEMAIRE, SHOWING THE CHIEF PERIODS OF INFECTIVITY OF BENIGN AND MALIGNANT TERTIAN AMONGST THE FRENCH TROOPS IN MACEDONIA, DURING 1916.

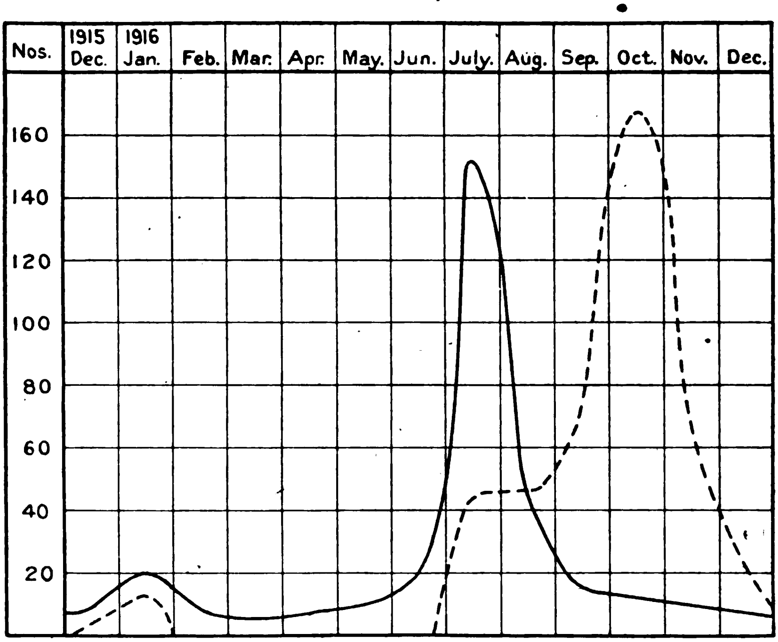


FIG. 4.—B. T. = ———; M. T. = - - - -.

Clearly, more has still to be learnt concerning the factors affecting the transmission of the different types of malaria by mosquitoes, and I can only venture to offer, tentatively, a few remarks upon the subject.

The infectivity of a mosquito is dependent upon two main factors: primarily, of course, upon the supply of gametocytes[1], and then upon the

[1] It may be as well to point out that the infection of new broods of mosquitoes at the commencement of a new season is almost certainly entirely dependent upon the supply of gametocytes in cases of recurrences and relapses; there is not the slightest evidence in favour of hereditary transmission of the parasites by the mosquitoes. It has been shown, further, that mosquitoes lose their infectivity during hibernation, the sporozoites degenerating and dying off.

biological and environmental influences affecting the developement of the oöcysts in the mosquito. As regards the latter influences, according to recent important experimental work by Roubaud (*Ann. Inst. Pasteur*, 32, 1918, p. 430), variation in temperature is the principal environmental factor affecting the infectivity of mosquitoes. Other variations in the conditions (e.g., the question of humidity) have apparently little influence on the successful sporogonic development of the parasites. Now it does not seem as if differences of temperature, in the different regions referred to, can serve to explain the matter. To judge from the isotherms given in physical maps, the average maximum temperature for the summer months is somewhat higher in Palestine than in Macedonia, South Italy occupying, probably, an intermediate position between the other two. The optimum temperature for the development of both types of the parasite is stated to be between 25° and 35° C. (77° and 86° F.), that for malignant tertian being probably slightly the higher. The minimum temperature at which the oöcysts can successfully develop is known to be the lower in the case of benign tertian. Probably, therefore—though I do not know of published data referring just to this point—the maximum temperature at which development can take place is, on the other hand, slightly higher in the case of malignant tertian. Hence the delay in the incidence of malignant tertian, both in the more hot climate (Palestine) as well as in the less hot one (Macedonia), can hardly be explained on this ground.

I have had an opportunity of discussing this question with my friend, Dr. J. D. Thomson, and I am indebted to him for suggesting that an explanation is probably to be found in a variation in the period when the supply of gametocytes, in the two cases, is most abundant in the human host. It may be of interest to consider this point more fully. In the first place, as the development of the oöcysts probably does not take, as a rule, more than about twelve days, most of the mosquitoes causing these principal outbreaks of benign and malignant tertian in June-July and September-October, need not necessarily have been—probably were not—themselves infected before early in June and early in September, respectively. Normally, of course, the indigenous malarial population serves to infect the local mosquitoes; and certainly, as regards Palestine, I do not think the presence of our troops was a factor of any great account in this respect. (The Indian troops might possibly be a slightly more important factor than the British.) Extremely few cases of malaria amongst the indigenous population were examined by me, and I do not know of any data relative to the period, or season of the year, when gametocytes of either type are to be met with most frequently in such cases.

It is clear, however, that if increased infectivity is principally due to an increased supply of gametocytes, this means that the production of the latter in the human source is most abundant (in the localities under discussion) early in the summer in the case of benign tertian, and early in

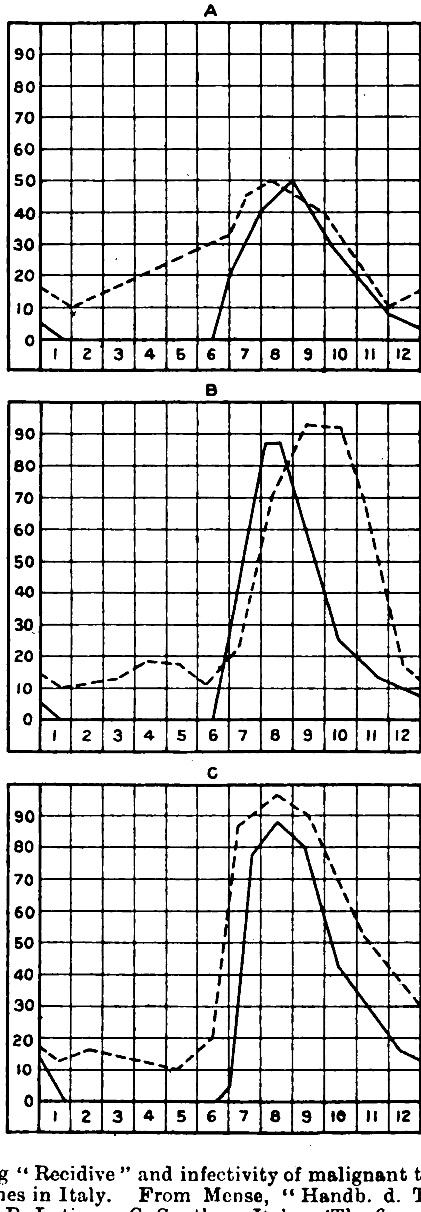


FIG. 5.—Curves showing "Recidive" and infectivity of malignant tertian, at different periods of the year, in various zones in Italy. From Mense, "Handb. d. Tropenkrankheiten," after Celli. A, Northern Italy; B, Latium; C, Southern Italy. (The figures of the *abscissæ* indicate months of the year.)

Relapses = - - - -.
New infections = ———.

the autumn in the case of malignant tertian. On this view then, it must be concluded that in the early summer, in contrast to what is the case in benign tertian, there are extremely few "Recidive" of malignant tertian (there must be, of course, a few, because there is a small amount of infectivity throughout the summer). That this may be the explanation of the delay in the incidence of the predominant season of malignant tertian infectivity can be reasonably argued, I think, from a consideration of the charts given by Celli, some of which (relating to malignant tertian) it is worth while to reproduce here (fig. 5, A—C). For comparison I give on the same scale, a chart (fig. 6) which might apply to malignant tertian in Macedonia or Palestine, the curve relating to relapses being, of course, a hypothetical one.

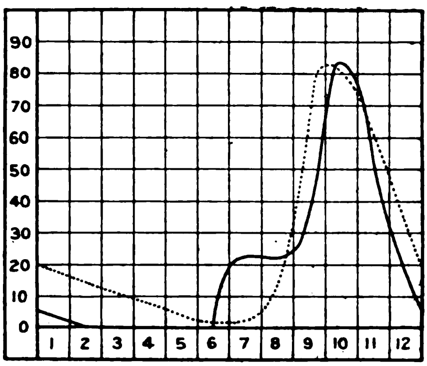


FIG. 6.—Hypothetical curve of the incidence of malignant tertian "Recidive" in Macedonia or Palestine, to explain the infectivity.
Relapses = - - - -.
New infections = ————.

From Celli's curves, it is seen that in Italy (all zones) there are a certain number of recurrences or relapses of malignant tertian during the spring and early summer, which doubtless provide the gametocytes for the commencing period of infectivity. Nevertheless, *the main season for such relapses coincides very closely with the main season of infectivity*, i.e., about August. (On the other hand benign tertian relapses occur in the main *earlier* in the year; though there is not quite the same degree of uniformity in the different zones that there is in the case of malignant.) Further, the degree of new infectivity stands in direct relation with the number of "Recidive," being highest (about) when the latter are most numerous. It is important to note that the numerical degree of the relapses in the spring and early summer *does* vary in different zones: thus it is lower for May and June in Latium and South Italy than in North Italy. All that is necessary, in our present case, is to infer that the drop in the "Recidive" curve for South Italy, for instance, about May is accentuated and continued through the

summer until the middle of August, or so. As is well known, relapses are due to various influences temporarily lowering the resistance of the body, such as hard work in the sun, chills through drenchings, insufficient food, and so on. If then we can assume that the vitality of the indigenous population afflicted with malignant tertian in Palestine and Macedonia is, owing to climatic factors and conditions of life at its best, as regards resistance to relapses, during the summer months we can hypothecate some such curve as that given in fig. 6 to explain the varying degree of malignant tertian infectivity during summer and autumn.

In the end, however, the question is only removed as it were a stage farther back. There still remains the unsolved biological problem, why is the chief period of benign tertian relapses at a different time of the year from that of malignant ones? Jancso's suggestion, that the difference is due to special biological peculiarities of the different species of parasite concerned, seems to be the only one applicable.

(*To be continued.*)

A GENERAL HOSPITAL WITH THE ROYAL SERBIAN ARMY.

By Colonel S. F. CLARK.
Army Medical Service (R.P.)

Some notes of one of our hospitals which was attached to the Serbian Army in the Great War may be of interest, as in addition to doing their bit in the actual work of the campaign, these units have played a valuable part in the political future of the Balkans. Many thousands of the present male population of Serbia were treated in the hospitals and so met "the English," who had been a mere name to them before, and these men are now our life-long friends; for many a long year in Serbian homes the tale will be told of the great hospitals which England sent so far to aid Serbia in her distress, and the remembrance of it will help to maintain the love and respect for our land which the war has engendered in that much tried country. England does not realize how intense is Serbia's gratitude to her.

Nos. 36, 37, 38 and 41 General Hospitals, and No. 33 Stationary Hospital, went to Macedonia to help our little ally. This account deals with No. 36, which was the first out and the first to take patients, and which was established at Vertekop along with No. 37. No. 38 remained at Salonika, No. 41 was seven or eight miles west of that place, while the Stationary Hospital, which came out later, opened at Sorovitch. The larger units expanded from 1,040 to 1,540 beds each, while No. 33 had 600 beds.

No. 36 mobilized at Aldershot, and on June 14, 1916, it entrained for Southampton and embarked there on the hospital ship Goorkha, which sailed the same afternoon. The Commanding Officer, registrar, quartermasters, and a handful of "other ranks" were the only regulars in the unit; the remainder were of the New Army, most of them leaving England for the first time. The medical officers were all connected with the Birmingham school, and were known to each other. The nursing sisters, who joined later, all belonged to the Territorial Nursing Service.

After an uneventful voyage the unit arrived at Salonika on June 25, and was followed next day by No. 37, but as many administrative details were apparently not settled, no disembarkation took place until July 3. It was ascertained, however, that the hospitals were to treat Serbians, under French administration, with the personnel under British jurisdiction, so that the unusual position arose of the units being visited later on by the Directors of Medical Services of three nations—each entitled to be there.

On July 2, as ordered, the Commanding Officers of Nos. 36 and 37 made a very early start to choose sites for their hospitals. They were accompanied by two French officers, who piloted them to the Oriental railway station, where a motor trolley that ran on the metals was produced,

and the party started on a long run up-country on the single line of the Salonika-Monastir railway. The journey in a new country was very interesting, the Vardâr was crossed on a fine iron bridge, and finally the Vertekop was reached, fifty miles by road north-west of Salonika, and considerably further by rail. The French headquarters staff wished the hospitals to be established at this place if possible, as the road and the railway from Salonika to Monastir met there, and the situation was a good one for receiving casualties from the front. The Commanding Officers thought it was rather an insecure spot to bring such large and immobile units to, but the point was not one for them to press. They hinted at it, but the French officers said that it was quite safe owing to the difficult nature of the country, but they disclosed the fact that there was nothing else to keep the enemy off at that time except a thin screen of cavalry.

The water supply was found to be a small spout of water coming from a built-up spring, and seemed rather inadequate, so Vodena and Vladovo, the next two stations beyond, among the hills, were visited, but as no level ground was to be seen at either place, there was nothing for it but to return to Vertekop, where there was plenty of flat ground. As Bulgarian shells were falling into the station next beyond Vladovo within a few weeks, it was just as well that the hospitals were not placed so far forward—although from Vertekop to Vladovo was only about eight miles. The spring at Vertekop was carefully looked at again, and as an assurance that it never dried up was received, and that arrangements would be made to collect the total flow, the Commanding Officers told the French officers (one of whom was a medical officer of high position) that they would undertake to establish their hospitals there. They would probably have thought twice about it, however, if they had known what a highly malarial spot it was. The long journey back to Salonika brought a very hot and tiring day to a close.

The hospital ships were then urgently needed in France, so next day the "Goorkha" was brought alongside the wharf and disembarkation was begun. The Commanding Officers were unwilling to open their hospitals until the water supply was arranged, but they volunteered to take their units up at once and to get everything ready.

The equipment of No. 36 was unloaded from the ship straight into railway trucks, and on July 6 it left in two trains with an advanced party, while the remainder of the unit went into an exceedingly uncomfortable rest camp, but on the 9th it also entrained for its destination. It found that the station-master at Vertekop had wanted to discharge the equipment at the station, utterly regardless of the fact that no road transport existed to convey it to the camping ground which was skirted by the line, but the trains were eventually taken along and the stuff dumped out of them on to the edge of the selected spot.

The country between Salonika and Vertekop was level, but now the mountainous region began. About five miles north of Vertekop was Vodena (Edassa), the ancient capital of Macedonia, standing high above

the plain with a very abrupt rise. The main road ascended here by steep gradients with hairpin bends. Vodena was the gate of one of the chief mountain passes to the north, and the road was many centuries old, being the ancient Via Ignatia. The railway line also used this pass, but reached it by a less abrupt ascent along a tapering ridge or spur thrown out from Vodena to Vertekop. At the lower end of this ridge the road and the line crossed each other, about half a mile from Vertekop station, and then they diverged, the one continuing along the flat to rise abruptly, and the other ascending the ridge—the two meeting again at Vodena. The hospitals were established between the road and the rail, No. 36 starting at the point where they crossed, occupying a comparatively narrow strip; then came No. 37 on the much wider expanse available by the greater interval between the two routes. No. 36 placed the whole of its personnel tents on the lower slope of the ridge, with the line separating them from the hospital proper, so that the railway practically ran through its camp, the tents on both sides of the rails being close up to them. This was done in order to utilize all the higher ground available, for fear of being flooded out in the winter, and events proved its wisdom. No. 37 had more ground, so the contrast between the arrangement of the two hospitals was very great, No. 36 being long and narrow and No. 37 widely spread and rectangular.

The water spout was just off the road, near the entrance to No. 36, and French engineers made a small covered reservoir between the hospitals, to which the water was pumped by an engine, and pipes leading from the reservoir to the hospitals were filled by gravity. It was a long time, however, before this work was completed, so that water carts had to be used for many weeks, during which the spring was policed. It was thought that the whole supply would be available for the hospitals only, but French and Serbian units became established close by, and thousands of troops marched up, who usually bivouacked on the other side of the road, so the one British "policeman" was often surrounded by a horde of French troops both black and white, or Serbians, all trying to fill their water-bottles—with water-carts waiting their chance to barge in. Tube wells were eventually sunk close by and connected up with the pumping engine, and this ensured an ample supply of water.

At first the two hospitals were separated by a watercourse, but No. 36 staked out a claim beyond it to allow for an expansion which soon came about. This extra ground became very useful as it was somewhat raised, and was cut off by the donga from the rest of the tents. It accommodated the dysenteric and enteric patients, and prisoners of war, and also provided an invaluable football pitch.

A great ditch was dug continuing the donga, which had silted up at one end, and which was in this way joined up with the water channel by the roadside, which also was much enlarged. In addition other pieces of heavy trench work had to be done, but they saved the hospitals from being drowned out during the periods of torrential rains which come on in due

season, and which taxed the defensive measures to the utmost. In fact the demand for labour for the many varieties of work which were necessary in a great camp like this, placed in the wilderness in the climate of Macedonia, was incessant, and the difficulty of meeting this demand was very great, especially as the heavy sick rate among the personnel shut off that source of supply almost completely.

On the other side of the ridge, which formed roughly the eastern boundary of the camp, was the Dragomantzi valley, and a French aerodrome was soon started there, which eventually gave birth to the only Serbian flying squadron in existence. These airmen built themselves dwellings on their side of the hill, without any attempt at symmetry, each man perching his house just where he pleased. A Serbian convalescent camp, and a two-hundred-bedded French hospital soon appeared close to No. 36, near the tip of the ridge, while a company of engineers located itself across the road, at the entrance to the hospital. It constructed fine bomb shelters, but was eventually asked to move farther away—which it did. For some time an Italian motor transport depot existed close to the French hospital, and in the spring a number of long sheds were erected on the far side of the road to shelter troops marching up country. All through the winter these passing men had bivouacked here in mud and rain, and it was wonderful that any of them kept their health.

The scenery from the camp was rather fine. Straight across towards the west, some ten miles off, was a high mountain range, well wooded, on which Naoussa was situated, where a convalescent camp for the hospitals' personnel was formed later on. To the north was Vodena, standing on a precipitous edge over which several large waterfalls could be clearly seen falling to the level below, and beyond it was the long, lofty Moglena range of mountains, held by the enemy. Looking east, from the top of the ridge, were more high mountains, while to the south-east and south was the open, more or less marshy ground to Salonika and the sea. The road to Salonika ran like a ribbon to the south-east, while the railway, which made a long detour, approached Vertekop from the west. For months all these mountain ranges were snow-capped, and the hospital knew it when the wind blew from the north. The boundary post between Macedonia and Serbia, on the top of Kajmachalan, 7,000 feet above the sea, always stood out clearly on the skyline.

The advance party had worked well, and the whole unit started at once to collect the equipment which was strewed all along the ground beside the railway line, and to erect tents. This last named proceeding was very laborious, for the ground was baked so hard that no wooden peg could be put in until a hole had been made for it by an iron peg and a sledge hammer. In addition, it was the middle of an unusually hot summer, with the thermometer on several occasions over 100° F. in the shade, so that manual work was impossible for some hours daily. To make up for this loss of time the men paraded at 4 a.m. Mosquitoes swarmed, and it was

soon evident that they were malaria carriers, and between them and the heat, dust, heavy labour and unaccustomed mode of life, malaria and dysentery soon made heavy inroads on the health of the unit. The officers had provided themselves with mosquito nets, and they were also supplied for the patients and nursing sisters.

All this time a battle was raging as to whether the British or the French were to supply the hospitals with everything needful—such as rations, food for patients, fuel, light, washing, etc., and in the end everything was found by England except transport for patients, engineering services, and electric light. Even tents for personnel were denied until it was pointed out that they were hospital equipment specially directed to be drawn overseas.

Within a few days fierce bush fires were raging in every direction and caused some anxiety—as the tents were as dry as tinder—and all hands were turned out one evening to attack a particularly menacing one. For the safety of the hospital, and to dislodge mosquitoes, all the long grass round the hospital was set on fire under supervision.

On July 18, within a week of its arrival, No. 36 took in sixty-three Serbian patients, although most of the matters referred to had not been settled. Tins of milk were borrowed on credit in every direction—to be paid back later on.

On July 28, the last marquee was pitched, the comparative slowness of this work being due to the heat, the iron hardness of the ground, the distances that everything had to be moved, and the effects of sickness. In addition the ground had to be cleared of bushes, boulders, and stones, and terraced in places, especially on the hillside. It was impossible to pitch a camp with the same rapidity as in France.

On August 1, fifty nursing sisters arrived for duty, and twenty-one more on the 14th, but in a few weeks their number was permanently halved. Various French and Serbian officers visited the hospital and put pressure on the Commanding Officer to open fully, but it was impossible to do so until the matters in dispute had been settled. As an offensive was projected and it was necessary to clear the field medical units, the two hospitals opened fully as soon as they got the food question settled, and left everything else to be done in the future. No. 36 at once got 1,000 patients, with no engineering work in the way of water supply, latrines, cook-houses, or ablution places completed.

The projected allied offensive was forestalled by the Bulgarians, who advanced rapidly round the practically open left flank of the allied line until the Serbians met them. By the middle of August wounded were coming in fast to No. 36, and the sound of the guns got nearer and nearer, the cannonade being very fierce and sustained. As the railway was in full use for reinforcements which the French poured up, the daily supply of food did not come, so after breakfast on August 25 there was nothing to eat in the hospital except the tinned stores, but supplies arrived in motor

lorries by road in the nick of time. On the previous day the firing sounded so near and fierce that the Commanding Officer issued brassards to all ranks without comment, and wondered how he could save the bulk of his personnel from capture. For about twenty-four hours the issue of the fighting, not very far off, hung in the balance, but the Bulgars were stopped, and by the end of the month the sound of the guns was distinctly more distant. From all accounts Vertekop had a narrow escape from being taken on this occasion, as the enemy made a determined attempt to reach the railway between it and Salonika. A few days later the Serbian attack on Kajmachalan was clearly seen, the flashes of the guns, the shrapnel bursts, and the spouts of earth ascending as shells struck the ground, being very evident.

By the end of August the shortage of staff from malaria and dysentery was so serious that a reinforcement of thirty N.C.O.s and men arrived, and convalescent Serb patients had to be used freely—even as ward orderlies—to enable the hospital to carry on. Vertekop was soon recognized as an unhealthy spot, and one of the places with a marked incidence of malaria. Few of any rank—sisters included—escaped at least one attack of it, although great efforts were made to keep down mosquitoes and to protect the men. Dysentery also was a constant cause of inefficiency.

On September 10, the Crown Prince of Serbia visited the hospital and expressed his gratitude for all that was being done for his men.

Leading from the main highway, the French engineers made a good road which ran through the centre of No. 36, across the donga by a substantial bridge, and through No. 37. On this road a single line of rail was laid down from the main line into No. 36 as far as about half-way to the donga, which was used by both hospitals. When arrangements were in order a train from up-country arrived daily and was shunted into this siding where it remained for two or three hours. The hospitals cleared it of cases as required on alternate days, and then placed in it patients for evacuation to Salonika. A French detachment was located in No. 36 which fed all passengers who were not taken off the train, for it was not strictly an ambulance train as known to us, but was an ordinary train with a certain number of the vehicles fitted up for casualties. Many other troops travelled in it—convalescents, etc.—all unarmed, and it often brought down trucks containing damaged guns and aeroplanes, empty shell cases, etc., and the French seemed surprised when objection was made to these trucks being left in the siding, and it was insisted upon that they be uncoupled and taken away to the station.

On September 24, 1916, a tragedy occurred on this siding. Several covered-in trucks had been brought into it, straw was placed in them, and they were filled with patients for conveyance to Salonika. All day long an engine was expected but none turned up, so the cases were left sleeping in the trucks. At Vertekop station an extra engine was always added to the end of every train going north, to push it up the long incline to Vodena.

To gain impetus for the hill the trains used to come along the level thousand yards at their utmost speed, but even then they often had great difficulty in getting up until more powerful engines were introduced later on. About 2.30 a.m. on this date a train was coming along the level "all out" for the ascent, but by some error it was turned into the siding and crashed into the trucks full of wounded. The wreckage was very great; the engine fell over on its side, while carriages and trucks were telescoped and smashed up, and climbed over each other, in the manner of a first-class railway accident. The loud crash of the collision was at once followed by the cries and wails of the occupants of the trucks, of whom thirteen were killed and over sixty injured. Rescue operations were begun at once, but it was several days before the siding was fit for use again, and weeks before all wreckage was cleared away.

On another night a train coming down the hill got out of control, and dashed through No. 36 at great speed, with its whistle going continuously, and finally came to grief by collision at Vertekop Station, to which the hospital sent down help.

On a third occasion a derailment occurred on the main line between the two hospitals, but with no casualties.

The experience of the unit with hostile aeroplanes may be related here. A day or two after its arrival a machine, with its black crosses plainly visible, appeared overhead, and seemed to be having a good look. It came daily, but it was thought that it must know that the units were hospitals, and no apprehensions of violence were aroused. On August 2, however, the Hun surprised everybody by dropping a bomb which fell on the hill behind the officers' lines. It was calculated that if the projectile had been loosened about one second later, it would probably have got the mess tent, in which about a dozen officers were having breakfast. A rush for souvenirs was made to the spot, and the plane then dropped four more bombs in rapid succession, which were meant to rake No. 36, but they fell on the other side of the road, causing a great stampede of mule carts which were moving along. It was really laughable to see the vehicles dashing off in every direction, throwing out the drivers and often overturning, but only one fatality occurred. Next day a large flag was made of sheets, with a cross of red ward screen cloth, which was fastened to the ground. On August 8 two bombs fell—one on each side of the hospital—without doing any harm. On 10th No. 37 got two bombs, and had two orderlies wounded. On 12th an air fight occurred overhead, and the Boche was driven off. Next day he appeared while the two units were at a combined open-air Church service—during the sermon. The chaplain was asked to stop, and the congregation was directed to scatter and lie down. Two bombs were dropped behind the hill, and the service was then resumed, the chaplain starting at the point at which he "was interrupted by that man." So far, never more than one plane had come, and a morning hate of two or three bombs followed by peace for the rest of the day came to be expected. At

dawn, on 17th, however, six or seven machines appeared, and dropped about eighteen explosive bombs and six incendiary ones—the great expanse of marquees being a tempting mark for the last named kind. The aim was not very accurate, however, and No. 36 escaped injury, but No. 37—a larger target—was hit several times, and had three persons wounded, both units getting off very luckily. The enemy had hardly cleared off when twenty-two more machines appeared, making straight for the camp, but after a certain period of anxiety they were found to be British, bent upon a raid of their own, and after buzzing round and round they went off. Next day the usual single plane came again, and killed and wounded several Army Service Corps motor transport men in the next valley.

By this time the Vertekop area had become a populous place, and a large French camp, with extra railway sidings, had grown up round the station, with a great accumulation of ammunition and supplies. On August 25 a duel took place over the hospital, which ended in the German machine being brought down, but after that the two medical units were unmolested for some time.

Early in 1917 a German formation, which was said to be Richthofen's famous circus, appeared on the Salonika front, and by means of two performances daily did an immense amount of damage in all directions, killing many men and animals and destroying much material. About March 5 a British hospital at the base was heavily bombed—either by mistake or not—and No. 36 at once set all available hands to dig narrow shelter trenches in the officers', sisters', and men's lines. They were just ready, but had no covering of any kind, when early on March 12 a telephonic message was received that a formation of enemy aeroplanes was heading for Vertekop. As it was about breakfast time nearly all ranks were in their lines close to the trenches, and almost at once about sixteen machines appeared in the sky, unopposed, and in complete possession of the air. Bombs began to drop at once on everything at Vertekop, a heavy attack being made on the station, where a huge ammunition dump was established. A train there at once steamed out to escape towards Vodena, but as it went through No. 36, and past No. 37, it was pelted with bombs. One fell in the men's lines within ten feet of the crowded trenches, another missed the serjeants' mess, and others fell so close that many tents were hit by the fragments all over the hospital. Eventually the enemy used up all his missiles and drew off, having caused many casualties all over the Vertekop area. No. 36 got off with three orderlies wounded, and several patients, and others engaged in the camp killed and wounded, but No. 37 had two sisters and four orderlies killed. Many men, including patients and convalescents, were killed and wounded in the units of our Allies. The shooting on this occasion was very accurate, and the trenches had proved their worth. From an enemy point of view the attack on the station was a great success, for not only were the station buildings hit (a small target), but the great ammunition dump was set on fire, and for the next twelve

hours the bursting of shells and the rattle of small arm ammunition was continuous. A store of high explosives went off with a devastating crash that was heard in Salonika; some people said that windows at the base were shaken.

After this No. 36 dug trenches all over the camp, and got some head cover on many of them. As telephonic messages were received at intervals that hostile planes were abroad, this method of being warned was relied upon, but on April 4, about six o'clock in the evening, without any warning whatever, the circus suddenly swept round the end of the ridge, and was over the camp at once. This time there was no train anywhere, and not even a vehicle upon the road, and No. 36 got the brunt of the attack. No. 37 was untouched, and some bombs fell near the station and the aerodrome, but No. 36 got 16 bombs, one of them, which had contained 120 pounds of explosive, making a crater 18 feet in diameter, close to one of the operating tents. Two occupied hospital marquees were set on fire and consumed, but, in spite of the suddenness and weight of the attack, the numerous trenches saved all hands from injury, and only one patient was hit—mortally. Some wards were saved by the travelling kitchen in the siding taking many of the flying fragments. This bombardment certainly seemed to be a deliberate one on No. 36, though the German *communiqué* pretended that the siding made it a railway station, which they said they set on fire. Captain A. A. Lees was awarded the M.C. for his conduct on this occasion.

After this episode a look-out man was constantly stationed on the top of the hill, with field glasses, and a flag for signalling down, while "lights out" blown three times in succession was declared to be an intimation for all hands to take cover. Although single planes often came over after this and the alarm was sounded occasionally, no more bombs were ever dropped on the hospital, but the news that the circus had left the Salonika front was received with much satisfaction.

In these two attacks taken together most of the tents of every kind in No. 36 were hit by bomb fragments, and it was marvellous that casualties were so few. On the last occasion two large bombs fell in the Sisters' lines but failed to explode.

As protection against night attacks, all lights and fires were concealed. and in one day all the tents were washed over with muddy water to prevent them from showing up white in the light of the moon.

No. 36 did not move from Vertekop, but remained for thirty-two months in the unhealthy wilderness. All the time it flew at its gate, at the junction of road and rail, the only Union Jack that was to be seen for many miles (except that of No. 37 next door), and all ranks had a feeling of pride in knowing that it was viewed in this desolate spot by many thousands of troops of our Allies who passed by. Somehow it looked finer there than ever it did in England.

The main duty of the hospital consisted in treating Serbians, but much

work was done with patients of other nations. For the first twenty months it took in all the sick of the British Motor Transport Companies attached to the Serbian Army that were in the neighbourhood, while large numbers of German and Bulgarian prisoners of war were admitted. In addition Frenchmen, Italians, Greeks, Russians, Roumanians, and Turks all drifted in, as well as an occasional Macedonian adult or child whose admission was demanded by humanity. The local people for miles around attended the out-patient department in such numbers that fees of chickens and eggs were exacted and placed in the hospital stores.

The Serbs were good patients, grateful and ready to help in any way. Comparatively few of them were young men, and as time went on and their own country seemed to be as far off as ever, they got somewhat downhearted. They were often reluctant to allow a limb to be amputated, and several lost their lives in consequence. The reason for this refusal seemed to be that there was a lack of provision for maimed men in Serbia, and so they feared the black future that lay before them.

For some time no interpreters were forthcoming, and at first it was impossible even to get the names of patients, or to communicate with them in any way, but this difficulty soon righted itself. It took some time to educate the early comers in regard to sanitary matters, and to impress upon them that neither the storm trench round their marquees, nor the ground just outside, were to be used as latrines.

The divisional officers and the specialists were first-rate men, supported by an efficient staff of all ranks and ratings, so the patients soon gained the utmost confidence in their treatment and showed their gratitude not only in words but in small deeds. To these homeless men, bereft of their families, the hospital was a haven of rest and the nursing sisters friends indeed.

The climate was naturally a source of interest. In summer it was very hot and dusty, and in winter, although there were many bright, lovely days, yet the heavy rain, the cold, the piercing winds, and the mud, made life wearisome. At intervals heavy gales blew for two or three days, which caused much splitting and destruction of marquee roofs, for the canvas rotted from its exposure to intense heat, rain, and snow, and lasted just about twelve months. The camp at times looked half wrecked in consequence after a "Vardar wind," while the heavy, and sometimes prolonged, rain tested the flood prevention works to the utmost.

The Serbs were clever at making wattle and daub structures which were vastly superior to canvas, and in time a fine canteen, sisters' ante-room, and sergeants' mess arose, along with sisters' night duty and ward duty huts—all of which were exceedingly comfortable and easily warmed.

The proximity of the hospital to the road made it a convenient house of call for travellers, and many visitors were received and welcomed at the officers' mess. Interesting sights were to be seen—troops of all nations going up in great numbers, French guns going down to overawe

Greece, disarmed Russian soldiers marching down under French escort (many of them made a dash for the hospital one day when they saw the Union Jack, and were pursued and beaten back by the mounted guards with the flats of their swords), and picturesque natives of all kinds with flocks and herds.

The unit had a good football team, which won a high place in a league contest with No. 37 and the Motor Transport Companies. It also had its own league between different sections in the hospital, and the game was invaluable in many ways. A capital pierrot troupe was formed, "waits" sang carols at Christmas, and walks and picnics helped to keep things cheerful. Vodena was a great attraction for all ranks.

The active career of No. 36 practically ended with the year 1918, and from first to last it had admitted some 30,000 patients, while, in addition, large numbers were taken out of the trains, dressed and treated, and then put in again to resume their journey to Salonika. Twenty Serbian officers and 634 of their other ranks died in the hospital; of these the fighting in 1916 accounted for seventeen officers and 306 other ranks. The hospital's own personnel, and the Motor Transport Companies, gave admission figures of 132 British officers, 167 nursing sisters, and 2,799 other ranks—an eloquent testimony to the unhealthiness of the area, for the great majority of these admissions were due to malaria and dysentery. None of the officers died, but one sister and nineteen other ranks succumbed—a few from bomb wounds. A second sister died just after transfer to Salonica, from acute mental strain due to aeroplane raids.

The unit selected a piece of ground for a cemetery, which was afterwards officially recognized. It had a large section for Serbs, and a smaller one for the other Allies. All the British dead were buried here, except three Army Service Corps men who were interred in the churchyard of a village near their camp, while the sister of No. 36 was laid to rest in Vertekop itself, in the shadow of the old, unkempt, village church. Escorted by one of her own countrymen—an orderly who quickly followed her—she lies there among French and Serbian troops and Macedonian peasants and children.

On the cessation of hostilities No. 36 began to melt away. It was formally closed on February 16, 1919, after which the remaining personnel left in large drafts, and the equipment was sent to Salonika. On March 12, the flags came down for the last time, with some ceremony, and the two officers and the handful of men who had remained to the end departed for the base. The first commanding officer had left twelve months before, and the staff of all ranks of 1916 had been almost completely changed, but these last officers and most of their men, who had volunteered to stay to the end, were original members of the unit.

All through a strong feeling of *esprit de corps* existed in the hospital, and most of its staff who left it did so with regret. Few went away without being seen off, either quietly or more ceremoniously.

The work of the hospital and the difficulties and dangers that it had encountered, were recognized by the award to the Commanding Officer of the Legion of Honour (officer), Order of St. Sava (third class), and the Croix de Guerre, while those serving under him gained one M.C., six A.R.R.Cs., one M.S.M. and sixteen mentions in despatches, along with seven St. Savas (fourth and fifth classes), nine Samaritan crosses (Serbian), three Serbian gold medals for bravery, and four Croix de Guerre. It is doubtful if any other general hospital in any theatre of war (except No. 37) can show an equally varied list of honours gained by its members.

THE PREVENTION AND DESTRUCTION OF RATS.

By Serjeant-Major E. B. DEWBERRY,
Royal Army Medical Corps.

(*Continued from p.* 350.)

Proprietary Articles.—With regard to the large number of advertised rat poisons, the following is a list of some of those at present on the market:—

(1) "Harrison's Rat Poison," obtained from G. W. Harrison, veterinary chemist, Reading. It is sold in boxes, from 6d. upwards; 2s. per pound in bulk.

(2) "Rodine" Rat Poison, sold by Thomas Harley, manufacturing chemist, Perth. This is put up in tins and sold at 6d. and upwards. Active ingredient probably phosphorus.

(3) "Bates No. 1." Prepared and sold by G. Y. Proudfoot, chemist, 181, Tower Gardens Road, Bruce Grove, N.17.

(4) "Extirmo" and "Exo," prepared by Extirmino Chemical Company, Limited, 16, William Lane, Dundee, N.B. The poison in these preparations is said to be phosphorus.

(4*a*) The "Patent Rat Destroyer Phosphor Paste," manufactured and sold by Roth and Ringeison, 57, Acton Street, Gray's Inn Road, London, W.C.1.

(4*b*) Blackmore's "Pied Piper" made by Jas. Price Blackmore, Professor of Verminology, 13, Churchill Terrace, C.-on-M., Manchester, and sold in tins at 2s. 6d. and 5s. each.

(5) "Sanford's Rat Poison," prepared by Sanford and Sons, Sandy, Beds, and sold in tins at 6d. and upwards. This poison is strongly recommended by "Sharpe" in Miscellaneous Publications, No. 22 (Ministry of Agriculture and Fisheries), under "Merits of Sanford," in which he says: "In the course of years I have tried many kinds of poison, including arsenic and strychnine, but Sanford's is the easiest to lay down, and is also harmless to cats and dogs, neither of which will touch it. Should a cat catch a rat which has been poisoned with it, fatal effects will only ensue if the cat eats the 'maw,' but I do not think this often happens. A rat does not die rapidly after taking this poison; perhaps that is one of the reasons why it proves so effective. If the first to eat died immediately, the others would have warning. After taking it, the rat becomes uneasy, and the cat may catch it whilst moping about. There is something peculiarly attractive to rats about this poison. The poison acts as its own bait. In using it, care must be taken to put it where farmyard fowls cannot get it. Otherwise they will pick it up, and death is certain. The same applies to pheasants, partridges and blackbirds. Thrushes will also take it if it is not

inserted a considerable distance into the rat holes. Being sent out ready for use, the method of applying it is extremely simple. My own plan is to collect beforehand an ample supply of small pebbles. These I take out of my pocket one by one, and plaster on each with a broad-pointed knife a little of the poison, a pellet, say, of about the size of a small hazel nut. This I roll well down into the next hole I come to, after which I at once prepare the next dose. There is no need to use bread or any other kind of bait. Some holes allow of the poison being dropped straight down without the use of a stone." This rat poison probably contains phosphorus as the active ingredient.

(6) "Hammond's Remedy," for destroying rats. Prepared by H. C. Andrews, 8 and 9, Essex Street, Strand, London, W.C., and sold in cakes at 1s. and 2s. each. It is claimed by the maker that "no smell is emitted from the dead bodies, as the remedy entirely dries them up."

(7) "Larter's Common Sense Exterminator," prepared by "Common Sense Manufacturing Co.," 21, Lime Street, London, E.C. This exterminator, it is said, "kills the fleas on the rat as well as the rat, and thus prevents the spread of plague, and will keep in any climate."

(8) "Londovus" Vermin Exterminator. This preparation can be obtained from the London Hygienic Chemical Co., Ltd., Wansey Street Works, Walworth, London, S.E., and is sold in tins at 2s. 6d. and 5s. each. The makers state: "After many years' experimenting and careful scientific research, this preparation has been proved conclusively that it not only kills the rat but consumes it. 'Londovus' is the safest and surest cure of the rat pest, and has no detrimental effects whatever." This preparation is said to contain barium.

(9) "Rat-quit": This rat poison is prepared and sold by Messrs. Lawson and Co., Ltd., St. Phillips, Bristol. The makers say :—

(i) Is the safest poison for rats, mice and small rodents, being prepared after consultation with the Board of Agriculture.

(ii) Is in paste form, convenient for use, and does not deteriorate on keeping.

(iii) The base of Rat-Quit has been approved and used by British and Colonial Governments, also by American and Continental State Departments, with the most successful results.

(iv) Its use involves no risk to human life or the larger domestic animals.

(v) It is packed in card vessels, each making about 1,000 baits.

Directions for use: For rats and small rodents, smear a piece about the size of a small nut (or half the quantity for mice) on small cubes of fresh bread. Apply freely for two nights in succession, then destroy uneaten pieces, and lay fresh ones again in a week's time, or until cleared. Lay bait in and about holes and runs, handling as little as possible." This preparation is said to contain barium carbonate.

(10) "Ratmus" Rat Poison is manufactured by the Zeba Company,

vermin specialists, 66, Seel Street, Liverpool, and is sold in tins at 1s. and 2s. each. The makers state that this poison "is quick in results and clean in effect. Its qualities include an entire absence of smell or other inconvenience."

(11) A rather novel recipe for destroying rats is given by H. Bracewell, 95, Cardigan Terrace, Leeds, as follows: "Rats are fond of Epsom salts; it sharpens their teeth. Put plenty down on the floor where they infest. Epsom salts make them very ill and savage; then they fight, kill and eat each other. Rats are cannibals, and never migrate after eating Epsom salts. Epsom salts are not poisonous."

A method of killing rats which is much in vogue in Germany is to fry small pieces of bath sponge or cork in bacon fat; this is then used as the bait.

Bacterial Virus.—In the Service, the use of bacterial virus for the destruction of rats is prohibited.

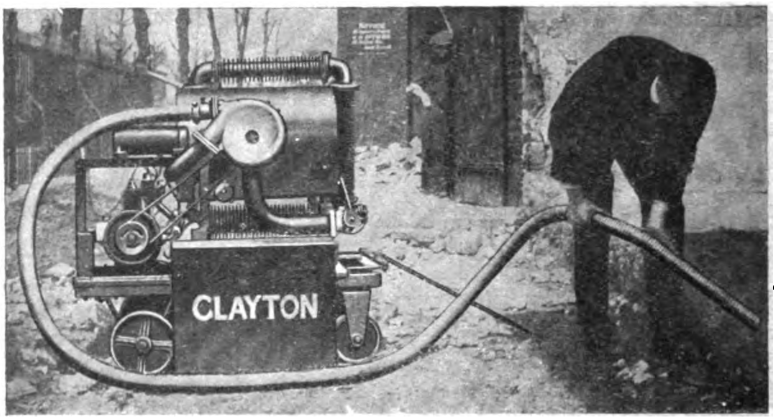
Fumigation.—Poisonous gases are frequently used to destroy rats in holds of ships, warehouses, stores, sheds, etc., and outdoors in burrows. The gases are sulphur dioxide, chlorine, carbon bisulphide, hydrocyanic acid and carbon monoxide. The fumigation of dwelling-houses is, however not recommended. Enormous numbers of rats are killed when ships are fumigated with sulphur dioxide. Rosenau says: "The s.s. 'Minnihaha,' a new vessel only nine months old in commission, fumigated in London in May, 1901, yielded a bag of 1,700 rats."

At a recent rat offensive in the King George Dock at Hull, 500 rats were destroyed in the steamer "San Jeronimo," one of the largest oil tank steamers afloat. The rats in this case succumbed to the effects of arsenical gas. The largest rat measured two feet from tip of nose to end of tail.

In a report to the Local Government Board by John Wade, D.Sc., dated May 7, 1906, the results of experiments are given on the use of sulphur dioxide for the destruction of rats, and an extract from the summary is given here: "Rats and insects would be destroyed in less than two hours by the uniform diffusion of at most 0·5 per cent of sulphur dioxide. This condition is easily and quickly realized in cabins and empty holds and in the space around the cargo in a loaded hold; but, owing to the extensive absorption of this gas, air containing three per cent of it must be circulated around the cargo from eight to ten hours to ensure adequate penetration. Moist foodstuffs, such as fruit, vegetables and fresh meat, are uneatable after exposure to sulphur dioxide, and wheat in bags is rendered useless for bread making; but, owing to the slowness of penetration, wheat in bulk is not seriously affected. Barley and maize are practically unaffected by fumigation with sulphur dioxide." ("Sulphurous Gas Process.")

Textile fibres and fabrics, metals and furniture are not affected by sulphur dioxide, but are liable to injury by the accompanying sulphuric acid when the gas is produced by burning sulphur, unless they are protected by means of a suitable covering. Jute in bales is not affected in any case."

The Clayton Machine, obtained from the Clayton Fire Extinguishing and Disinfecting Co., Ltd., 22, Craven Street, Northumberland Avenue, London, W.C. 2, is the one generally used for fumigation by sulphur dioxide (sulphurous gas process). Small cylinders containing the gas liquefied can also be used in fumigating rat burrows.



Method of destroying rats in their runs.

Carbon bisulphide can be used for asphyxiating rats in burrows, but care must be exercised in its use, as this chemical is highly inflammable and volatile; smoking must not be indulged in during the operation. The liquid is poured on to cotton wool, or cotton waste, and by means of a long stick this is pushed well down into the burrow which is known to be frequented by rats, after which, both the entrance and outlet to the burrow are tightly closed with earth. The liquid quickly volatilizes and the vapour asphyxiates the rats. Carbon bisulphide is best applied after rain. Care should be taken not to inhale the vapour as it is poisonous. Whenever poison is used for the extermination of rats, it must not be used indiscriminately, and the person entrusted with this work should be instructed in the following points:—

(1) To use the greatest care in mixing and handling the baits; (2) only the minimum amount of poisonous material should be used; (3) to give full warning to all concerned that poisonous baits are being laid down, and that any portion unconsumed by the rats is collected; (4) to prevent domestic animals from gaining access to the baits, or to the bodies of poisoned rats; (5) to see that the unconsumed baits are collected, and that all dead rats are buried or burned.

(*b*) *Trapping.*

There is a considerable number of traps of various sorts and sizes now on the market for killing or catching rats, but it would be almost impossible

to dwell upon the merits or otherwise of all these, and only those which have been found to give good results will be dealt with here. Mechanical traps of different kinds can be readily improvised.

Trapping should be carried out continuously after the use of poison has somewhat decreased the number of rats, and the remaining ones have begun to fight shy of the poisonous baits. Sharpe says: "There is always a proportion of the rat population which survives the poisoning campaign, and these are the animals against which a more patient and gradual process must be applied. The survivors can be cleared off by trapping before they have acquired the cunning which enables them to avoid risks. A large proportion of rats become trap-shy before the process has progressed very far. The same is true of poison if the mistake is made of laying it in sections.

Photograph by Serjt.-Major Scott-Budcock, R.A.M.C.

Trapping must at all times be carried out systematically, and special attention should be given to drains and ditches. It is said, that the most expensive trap, unless properly handled and set, is useless, but that a cheap trap in the right hands, set in a correct manner, may catch numbers of rats. In trapping, far less depends upon the kind of trap than upon the trapper, and a man smart at his work will often catch rats with the most primitive contrivances. Whatever form of mechanical trap is used, it must be handled as little as possible in setting, as rats are very cunning animals with a keen sense of smell, and unless some precautions be taken the trap may be betrayed by its odour. This can be avoided by

adopting one of the following precautionary measures: (1) Wearing gloves; (2) smearing the hands with some essential oil, such as oil of rhodium or aniseed; (3) well rubbing the hands with earth. The same type of trap should not be set for more than one or two nights, after which another kind should be tried. All traps should be kept clean, carefully examined

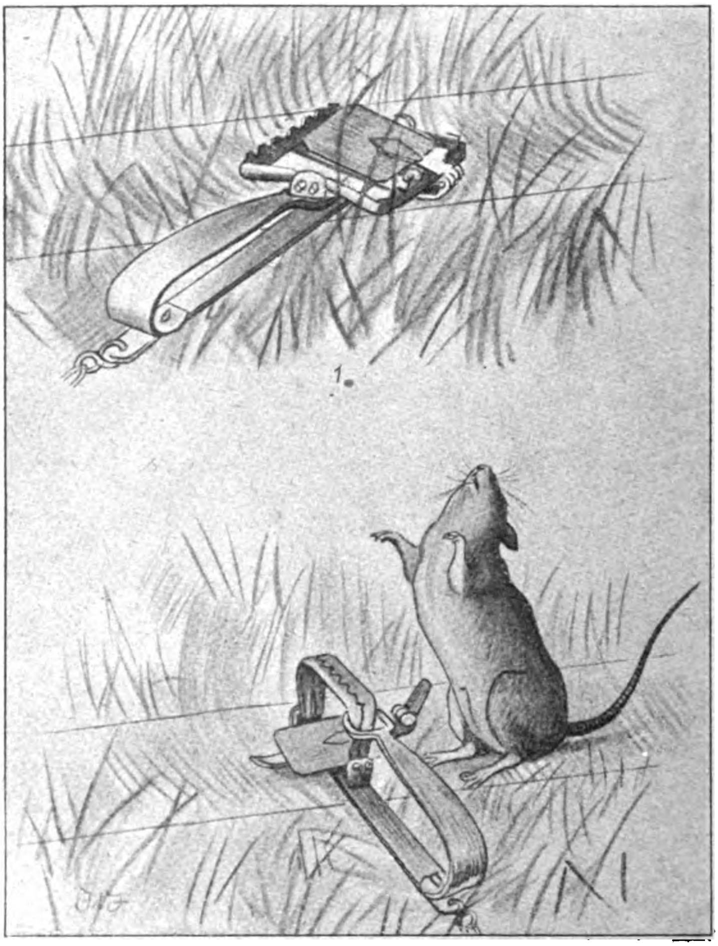


Illustration taken from the pamphlet, "Rats and how to exterminate them," and reproduced by permission of the Controller of H.M. Stationery Office and the Ministry of Agriculture and Fisheries.

before use to see if they are in good working order; and oiled when necessary. The mechanical traps which have been found from experience to give satisfactory results are the following: (1) The "steel gin" (or toothed spring trap.) This can be obtained direct from Henry Lane, Eagle Works, Wednesfield, Staffs, and is called "The small Dorset vermin trap, No. 4." (Price 30s. per dozen.)

(2) "The Breakback Trap," "The Nipper and the Sentry"; these are made by Proctor Brothers, Limited, Leeds Wire Works, Call Lane, Leeds. Price 13s. per dozen.

(3) "Wire Cage Traps," (used for catching rats). There are various patterns of these traps on the market, some types of which can be purchased direct from Alfred Clifford, Hawley, Kent. They can also be obtained from ordnance stores.

(1) *The Steel Gin.*—This trap is set unbaited in rat runs. It should be placed lengthwise with the run, as in the illustration given on p. 413.

It should never be set across the run, as when the rat touches the "plate" the jaw of the trap is released, rises under its belly, and throws the rodent out of the way of the closing teeth. This is certain to happen if the gin is approached on the side where the jaw is held down by the catch (see illustration on p. 414).

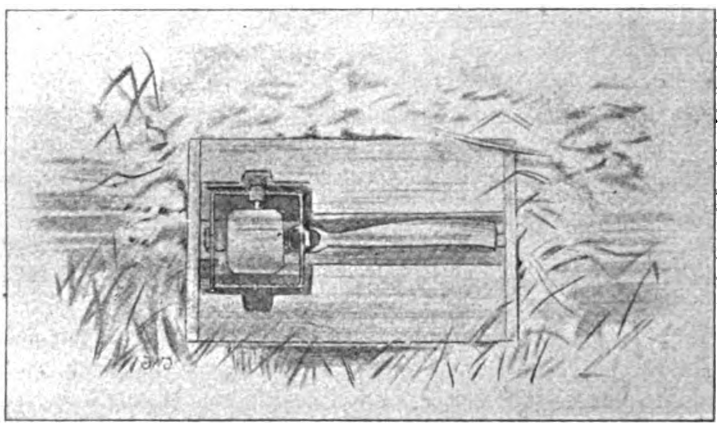
The trap must be carefully set (as "light" as possible), placed firmly in position, and secured to the ground by means of the chain and a strong peg. Earth or chaff is now lightly sifted over the whole trap so as to completely hide it from view, at the same time the surrounding earth should be packed as tightly as possible so as to make the ground look quite natural. The earth or chaff used for covering the gin should not be touched with the hands. The idea to be aimed at in setting a gin is not to disturb the natural surroundings and general features of the rat run more than necessary. Sometimes it is possible to set a trap at the entrance or just inside a rat hole. In this case some of the earth will have to be dug out in order to have the trap properly level, etc., but the ground should be made quite firm afterwards; no raised earth should be left indicating the spot where the gin is set.

In order to prevent the trap being "sprung," when sifting the earth or chaff over the plate and catch, a small stick should be placed under the plate and resting on the jaw to keep it in position during the operation, as shown in illustration on p. 416.

The material used for covering traps should match the surroundings; this may be leaves, grass, earth, chaff, or earth mixed with leaves, whichever is most suitable for the purpose.

The steel gin can be set to catch rats in their runs in wet ditches, and is so placed that the water just covers and conceals it, but not any deeper than about one-sixteenth of an inch below the surface of the water. Traps so covered are not betrayed by their odour. An excellent trap, in which the steel gin is used, is given in the "Book of the Rat," published by the proprietors of the Liverpool Virus: "Get a bag of clean fine sawdust, and mix with it about one-sixth its weight of oatmeal. Obtain the sawdust fresh from under the saw, without bits of stick in it, as these would be liable to get into the teeth of the trap and stop them from closing. Where you see the runs, put a handful in, say about thirty different places every night, just dropping the sawdust and meal out of your hands in little

Photograph by Serjt.-Major Scott Budcock, R.A.M.C.



RAT-WATER-TRAP (FROM ABOVE).

Water just covering surface of trap. Raft and trap should be hidden by scattered grass (grass omitted in drawing to show trap).

Illustration of Rat-Water Trap taken from the pamphlet, "Rats and how to exterminate them," and reproduced by permission of the Controller of H.M. Stationery Office and the Ministry of Agriculture and Fisheries.

heaps. That means thirty different heaps. Do this for four nights, and you will see each morning that the sawdust is all spread about. Now for four more nights you must bury a set trap under each heap of sawdust. Thus you will have thirty traps, on each of which there is a square centre plate; you must level the sawdust over the plate with a bit of stick, and set each trap as fine as you can on the catch spring, so that the weight of a mouse would set it off. They will play in the sawdust as usual, and you will have rats in almost every trap. In time, however, the rats will cease to go near sawdust. Then you must procure a bag of fine soot from any chimney-sweep, and you will find that they will go at the soot just as keen as they did in the first instance at the sawdust. When they get tired of soot, which they will in time, you must procure some soft tissue paper and cut it fine, and use that in the same way as the sawdust and the soot. You can also use light chaff or hayseeds with the like result."

In Miscellaneous Publication No. 22, issued by the Ministry of Agriculture and Fisheries, on "Rats: How to Exterminate Them," a water-pit trap for rats, for use in poultry yards, is given. Sharpe says: "I procured a tub, which was really the half of a paraffin barrel, and, having made a framework to fit the top so that it would take six traps, I set it according to the usual plan. An island was formed in the middle of the tub to take the bait, and to prevent its removal a fine wire mesh netting was placed on top. The tub was then sunk level with the ground, the water being filled in so as just to cover the traps before-mentioned sixteenth of an inch. The results were marvellous, the whole of the rats being cleared off in a very short time. The traps remained set afterwards, with the result that any stranger coming along promptly fell a victim. I used any kind of bait—one time a rabbit paunch, another a fish head, then bacon rind, and so on. To prevent the poultry, cats or other legitimate farmyard inhabitants sharing the fate of the rats, the whole outfit was surrounded and covered with framework carrying two and a half inch wire netting. It thus lay in full view, but inaccessible to everything but rats."

It may be as well to mention that sometimes a rat is caught in the steel gin by its leg; in this case he may bite off the limb, and escape, but is afterwards generally killed and eaten by his comrades, as this practice (the survival of the fittest) is peculiar to the rat tribe. Should this occur, it is best to change the type of trap, as if it is left set it will only be shunned by the other vermin.

(2) *The Break-back Trap.*—This is quite a good trap, and is an improved type of the old penny "break-back" which was used for catching mice, but stronger and larger, and fitted with a moveable platform which, when touched by a rat, springs the trap. The trap is baited, but the rodent has not much chance of obtaining possession of it. After a rat has been caught the bait should be changed.

The "break-back," as its name implies, is a most excellent contrivance for catching and killing rats indoors, and it can be used outdoors in dry weather.

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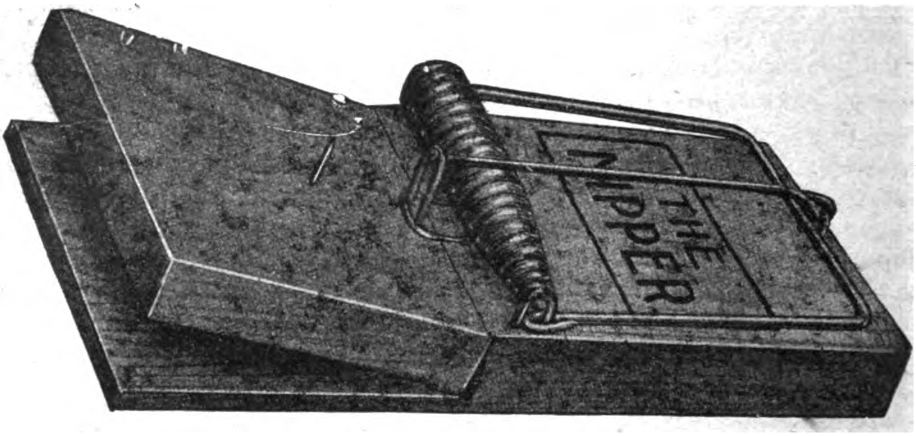
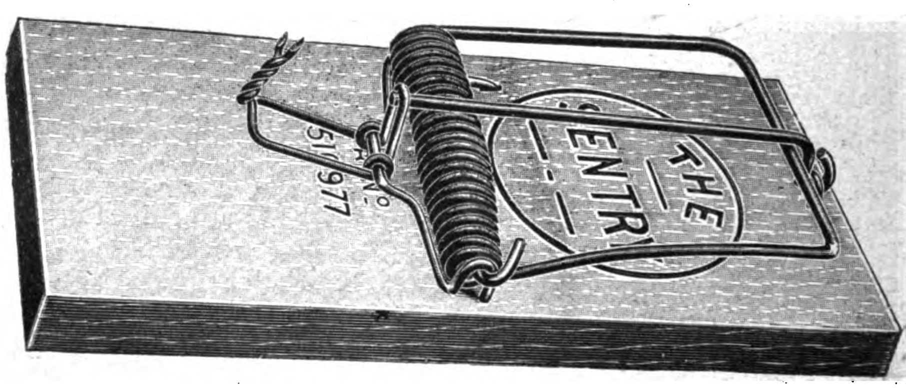
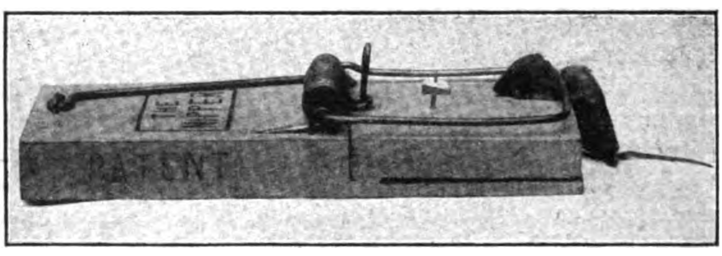






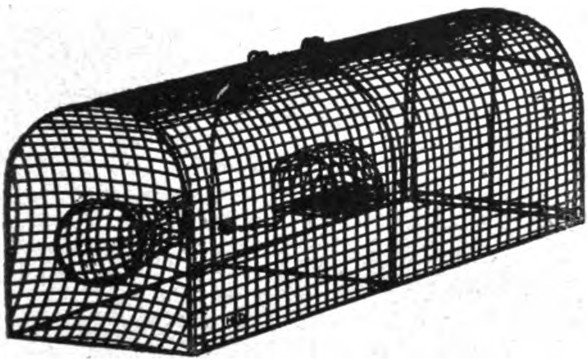
Mouse caught in a rat-trap.

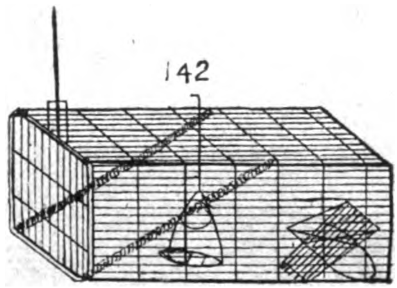
When the trap is sprung it catches and kills the rat at once, after the manner of a guillotine, and it is possible to set it so "light" that it goes off at the slightest touch. An illustration of this is given on p. 418.

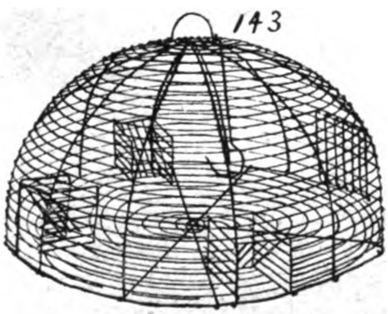
Any suitable bait may be used for these traps. The following receipt for the bait is given by Boulter in "The Rat Problem": "Take a pound of good flour, three ounces of treacle, and six drops of oil of carraway, put them all into a bowl, and be sure to mix them well; then put a pound of crumbs of bread to it."

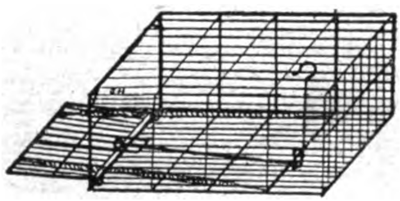
(3) *Wire Cage Traps.*—There are several varieties of wire cage traps on the market, and these often prove very effective in such places as forage barns and granaries. They work on the principle that they allow the rats to enter but prevent their escape. One of these, called the "Brailsford," is a very good type of trap.

The following illustrations of various wire cage rat traps are of those manufactured by Messrs. H. T. Dobson, Limited, 84, Borough, London.





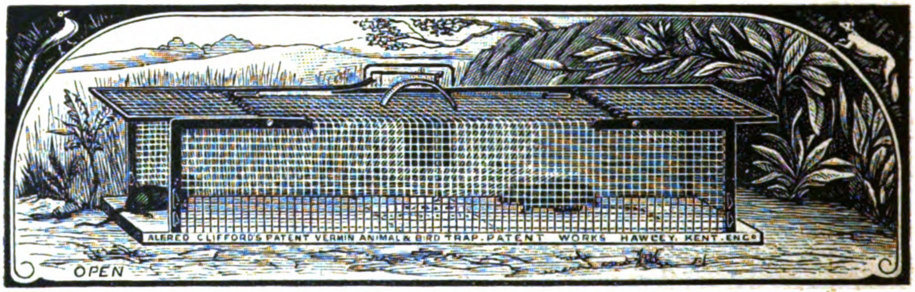


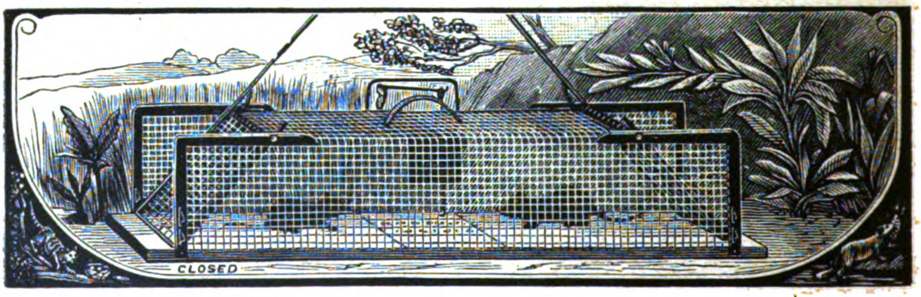


Alfred Clifford's Patent Trap.—The maker states: "It is one of the best traps for catching vermin, animals and birds that has ever been invented; it has a trap-door in centre of floor, and when set is perfectly level and cannot be noticed; the bait only requires to be laid on the floor of trap; immediately the animal puts its weight on the hinged floor, the

doors close; it has a clear space right through, thus causing no suspicion whatever. Strongly made in galvanized iron and painted. It will catch dozens where other traps are useless. The traps can also be used for catching laid-up ferrets by placing them in front of the holes; the trap illustrated on this page is two feet six inches long, and can be obtained from Alfred Clifford, Hawley, Kent.

A considerable amount of time and patience is required when using cage traps, as it is useless to try and catch rats with one straightaway; the trap must be dummy-set for several nights before there is any likelihood of catching any of the vermin. The following procedure should be adopted: The trap should be well baited, handled as little as possible, and set with both the doors open; that is, the trap door is fastened up, and



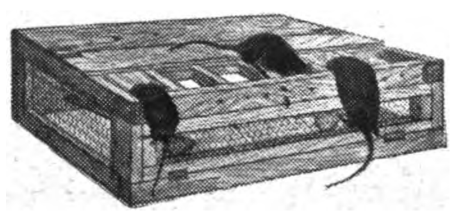


the door at the further end also left open; this is done in order to allow the vermin to enter, consume the bait with impunity, and escape—in other words, "make themselves quite at home." The wire cage is hidden as much as possible by covering it over with straw or other suitable material. After this procedure has been gone through every night, and the rodents have got used to running in and out of the trap, it is then correctly set, and, if the preliminary measures have been intelligently carried out, a good haul of rats should result. The vermin should be killed by putting the whole cage in a tub of water.

The "Outwit" Rat Trap, manufactured by J. Simpson and Sons, Otley, Yorks.—The makers state: "To meet all the needs attendant on the rat scourge, we have given considerable time and thought to the making

of a really effective trap which will catch and kill quickly quantities of these pests. The result, after repeated trials and exhaustive experiments, has been the 'Outwit' rat trap."

This appears to be a small storehouse made of wood and enclosed in wire netting. The whole of the basement of the trap, which has an iron bottom, can be filled with any food the rats are most used to stealing, such as corn, meal, pig food, etc., as these usual foods cause least suspicion. The rats can then see an abundance of food which is apparently beyond their reach. Seeing no entrance round the sides, they immediately climb on top of the trap, and find that there are plenty of ways inside, and that the food is easy to obtain. They have entered troughs from the top for generations. The only projections are perfectly natural and innocent strips of wood, arranged in such a way that they form necessary steps to more easily reach the food. Rats have no hesitation in walking on plain pieces of wood which are not baited, and yet the very innocence of the wood is their undoing. Immediately a rat touches one of these pieces, however lightly, with its front paws or nose, a very powerful spring is released, which forces



The "Outwit" Rat-Trap.

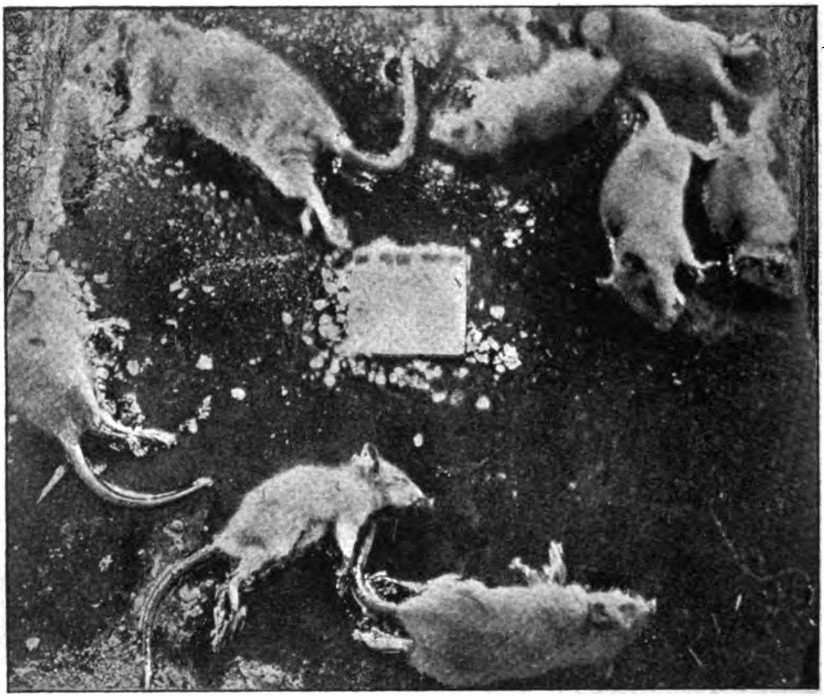
a killer forward at lightning speed, and these are so arranged that it is impossible to miss the rats. In each trap there are six holes and six killers arranged to catch and kill six rats at one setting." Full directions for setting are sent free with each trap.

Auxiliary Methods of Trapping.—In addition to traps that kill rats at once, boxes, tubs and pits with sides sloping outwards to the floors are effective; rats which have entered are unable to escape, and can be killed at leisure. In these traps a decoy rat may be placed with advantage; a female, immediately she has given birth to a litter, makes the best decoy.

The Pit Trap.—This is made by sinking a wooden barrel in the ground, the top of the barrel being level and in a line with the rat run. The barrel is provided with a light wooden lid, made in two sections; each section swings on a rod, and is weighted near the edge, in the manner of a trap-door. A suitable bait is fixed on the centre of each of the swing covers. The rat, running on to the lid of the barrel to obtain the bait, is at once precipitated into the tub; the section of the lid, being weighted, returns to its original position.

Another form of trap is made by covering the top of a large tub or

barrel with stout brown paper, several pieces of timber being propped up against the tub so that the rats can easily climb up to the bait ~~which~~ is placed on the paper, and must, of course, be frequently replenished. This is allowed to go on for a time, the rats carrying away the bait with impunity; later the paper is slit in the form of a cross, the slit being continued to the edge of the barrel. The vermin, on endeavouring to secure the bait, fall into the barrel. A brick should be placed on end in the bottom of the barrel, and water poured in up to the level of the top of it. In this way, other rats will in all probability be attracted by the screams of the rat already trapped, and caught in the same manner. If desired a similar swing cover, in sections, as described for the "pit trap," can be fitted to the barrel.



Birdlime Trap.

In Economic Series No. 8, British Museum (Natural History)—"Rats and Mice as Enemies of Mankind"—a description is given of an inexpensive contrivance for catching rats which was invented by two Swedes: "A wooden stockade about three feet six inches high is erected so as to enclose a triangular space, of which each side is about twelve feet in length. In one of the sides is a gap eighteen inches to two feet wide; this gap is closed at will by means of a heavy slide held up, when the trap is open, by a cord and pulley. In the base of the side opposite to the gap is fitted a funnel, of wide enough bore to admit of the passage of a rat; the

funnel opens into a sack placed behind the stockade. The inner side of the stockade is smooth, so as to give as little foothold as possible to rats attempting to climb out; and old iron plates or tiles are placed so as to overhang the edge of the stockade, inclined at a suitable angle to prevent the rats leaping out. The trap is baited with any attractive stuff, such as old bones or a dead dog; the slide is opened and the rats are allowed to regale themselves freely for a time. Later the man who is to work the trap secretes himself; when he judges that enough rats have entered the enclosure he releases the cord controlling the sliding door. The operator and his comrades then hurry to the trap, and scare the rats by beating the sides of the trap; the rats, unable to climb or jump out, soon discover the funnel and pass through it into the sack. When the sack is full, a board is dropped over the mouth of the funnel, and the men beat the sack with shovels until all the rats within are killed. With this trap the inventors caught upwards of 5,000 rats in a very short space of time."

In addition to the usual methods of trapping, "birdlime" has also been employed. This is spread on wood, or iron trays, and a suitable bait placed in the centre of the tray. The rats are attracted by the bait, held by the birdlime, and eventually die of asphyxia. This method of catching rats and mice is used in Japan.

Dr. Hanna, writing on the subject of "Birdlime Traps," says: "In Liverpool, for the general treatment of rats, we have relied on a special birdlime tray, with which excellent results have been obtained. It is necessary to observe the habits and study the haunts of the rats by close observation before putting the trays down. Rats, as a rule, run close to pipes and walls so as to come to the water supply and food; the whiskers of the rat no doubt act as feelers to guide him in the dark, and hence we find their tracks and runs in such situations.

"The birdlime preparation is made with linseed oil and resin, and the trays of birdlime require some attention; it is necessary from time to time to break the surface of the birdlime layer so as to renew the film, and the trays must be carefully laid during the evening. Some attractive bait should be placed in the centre on a piece of cardboard, which must not be submerged; the bait may be varied according to circumstances."

(c) *Hunting.*

Ferrets, and sometimes polecats, are used for the purpose of causing rats to bolt from their burrows. The rats are then either trapped in nets placed at the end of the burrows, or caught and killed by dogs or by men armed with sticks.

It may not be out of place here to give a few hints concerning ferrets. Ferrets are of two distinct colours, viz., the white ferret, with pink eyes, and the rich dark brown and tan coloured ferret. For rat hunting, one is just as good as the other; but the female should always be used, as it is only about half the size of the male, and consequently she can follow the

rat in a very narrow run; in fact, she is able to follow a full-grown rat anywhere. When purchasing ferrets, obtain young ones, from nine to fifteen months old, as they have more courage than old ones, but they will require training. If possible, secure a long, dark-coloured female ferret, as a small one has not sufficient weight to tackle a rat. Carefully examine the ferret's feet to see that these are quite clean. If the underside of the feet are black and the claws dirty, do not purchase it. The ferret will no doubt at first be wild and savage, and it must be constantly handled till it becomes quite tame before it is used for any work.

The natural food of ferrets is the flesh of small animals, and they should be given small birds, mice, etc. The day before the ferrets are to be used for rat-hunting, it is best to feed them in the morning on bread and milk; they should not be given any food on the day they are working: this tends to make them keen. The ferrets must be strong and well nourished, otherwise they will not have the courage to face the rats. In picking up a ferret, do not get hold of it by its tail or hold it by its head. It should be grasped lightly round the shoulders, with its front legs hung gracefully out below from the fingers. Should a ferret get bitten during the day's work, it should not be used again until it is quite well. The wound should be swabbed with tincture of iodine, and the ferret placed in a quiet box by itself. A ferret should on no account be muzzled when it is used for hunting rats. Ferreting can of course be carried out practically anywhere where rats abound, but ferrets are used chiefly for hunting in stables, under floors of barns and sheds, stacks and suchlike places. Numbers of rats are frequently killed during the threshing season. It is best to surround the wheat stack with a temporary rat-proof fence, four feet high, sloping inwards, the fence being erected about eight feet from the stack, so that the rats cannot climb over it.

It has been suggested that the men who travel about the country with threshing machines, which they let out on hire, should also carry this rat-proof wire netting with them as part of their equipment, so that it can be erected by them on arrival at the scene of operations; this would no doubt save time, trouble and expense to the farmer concerned, and the wire netting could be used over and over again for the purpose. Great care should be taken to prevent ferrets obtaining access to fowlhouses or hen-coops, as they would soon kill all the birds. Dogs are often used in connection with ferreting. They must be well trained beforehand so as not to interfere with the ferrets. A good working terrier is a big asset in rat-hunting, provided of course the dog has been educated up to play his part. At night rats can be killed by means of the "flashlight method," i.e., if a strong light from an electric torch is suddenly flashed on a rat, it becomes dazed, and can then be easily knocked over with a stick or killed by a dog.

In conclusion, it is hoped that the information contained in this article may be of some value to those who are employed or interested in the prevention and destruction of rats. There is no need to emphasize or

dwell upon the enormous amount of damage done annually to property and materials, both in civil and military areas in Great Britain, by these vermin, and the grave menace that they are to the health of the troops and civil population. The rat campaign is now being prosecuted all over England; the civil authorities are inaugurating "national rat weeks" so as to obtain simultaneous destruction of the vermin throughout the whole country, consequently there is a general need of organization and co-operation in order to be able to tackle this problem, which requires the greatest energy and zeal of all concerned. In an anti-rat campaign, no matter what measures are adopted for killing the rats, they must be persistently and systematically pursued as long as a breeding stock of rats remains. In the Service, it is understood that working pay at sixpence per diem is to be granted to men performing the duties of ratcatchers, and it is hoped in this way to arouse an intelligent interest amongst the troops in the work of rat extermination. It has been suggested that large and suitably illustrated posters be distributed throughout all barracks, camps and hospitals, etc., calling attention to the vast depredations of these rodents, and that, besides the officer appointed to supervise the anti-rat measures, squads of men be specially trained in the art of rat-catching, so that they may be able to take an active part in the campaign, and at the same time co-operate with and assist if necessary the civil inhabitants in the practical extermination of this pest in the areas surrounding military camps and barracks, as it must be remembered that rats hunted on one side of a boundary can seek refuge on the other side, where the human community may perhaps be more lenient towards them.

The writer expresses his thanks to Major J. H. Peek, R.A.M.C., for his valuable suggestions, to Serjeant-Major W. H. Scott Badcock, R.A.M.C., for furnishing the photographs so necessary for the purpose of illustrating the various practical methods for catching and killing rats, and to the Secretary of the British Museum (Natural History) for permission to reproduce the illustration of the black and brown rat.

First, plague in rats;
And then in fleas;
Then plague in man,
And quick disease.
No rats, no fleas,
No plague disease.

(Government Health Department, U.S.A.)
1912.

DIFFERENTIATION OF SIX STRAINS OF STREPTOCOCCI ISOLATED FROM CASES OF LATENT SEPSIS.

By Lieutenant-Colonel A. E. HAMERTON, C.M.G., D.S.O.
Royal Army Medical Corps.

The strains of streptococci examined are numbered respectively 11,693, 11,292, 11,299, 11,700, 11,699, and 11,702.

They were all isolated from cases of latent sepsis in old gunshot wounds under treatment at the Herbert Hospital, Woolwich, and have been used in the preparation of latent sepsis vaccine as advised by Sir Kenneth Goadby, who sent the strains to the Royal Army Medical College for investigation.

The characteristics of each strain so far as they have been worked out are noted as follows:—

Strain 11,693 was isolated from a quiescent case of old gunshot fracture of femur in which a secondary operation was performed for the removal of a sequestrum. The operation was followed by a "flare" of sepsis presumably caused by this organism.

Morphology.—The organism grows in short chains of ten to thirty cocci. Growth in glucose broth—flocculent and ropy, sedimenting to the bottom of the tube, leaving clear medium above. Growth on glucose agar (reaction + 10 acid)—scanty discrete dew-drop like colonies. Grows better on + 4 media.

Hæmolytic Test.—Half a cubic centimetre of human blood smeared on an agar slope was completely hæmolysed after twenty-four hours' incubation. The test was repeated as follows: 0·5 cubic centimetre of a twenty-four hours bouillon culture was added to 0·5 cubic centimetre of a 5 per cent. suspension of washed human red blood cells and incubated for two hours in a water bath at 37° C. Results: complete hæmolysis in two hours. A control, put up with a strain known to be non-hæmolytic, showed no hæmolysis after two hours, and only slight hæmolysis after twenty-four hours.

Fermentation Tests.—This strain produced acid fermentation in lactose, saccharose and salicin media, acid and clot in milk after forty-eight hours, but no reaction in mannite and inulin, and no reduction of neutral red.

Serological Test. (1) *Preparation of Agglutinable Culture.*—Strain 11,693 was cultured in human ascitic serum broth for twenty-four hours. The growth was centrifuged, the medium pipetted off and replaced by normal saline solution. The centrifuging and washing with saline was repeated three times, and the emulsion diluted to a suitable degree of opacity with normal saline to which 1 per cent. formalin had been added. The tube was then sealed off and shaken in a mechanical shaker for two

hours. This sample of emulsion was subsequently found to be unsatisfactory by reason of spontaneous agglutination. It was therefore discarded and another sample was prepared by exactly the same method, incubated for forty-eight hours and subjected to repeated shakings in the electric shaker. This emulsion proved reliable when tested against the serum broth in which the organisms were grown, and by the usual controls when put up against its specific agglutinating serum, and it was not agglutinated by normal rabbits' serum.

(2) *Preparation of Agglutinating Serum.*—A vaccine was first prepared from a twenty-four hours' growth of strain 11,693 in horse serum broth. The vaccine was killed by heating to 60° C. for thirty minutes in a water bath, and, after repeated washings, 0·5 per cent. carbolic acid was added to the normal saline holding the cocci in suspension. A count of the vaccine showed a yield of 400 million streptococci to the cubic centimetre.

A normal rabbit was then inoculated with a primary dose of 44 million cocci given subcutaneously. Subsequently doses of 200 millions, 400 millions, and 800 millions, followed by two doses of 1,200 millions were given intravenously at weekly intervals extending over a period of six weeks in all. Seven days after the last inoculation the rabbit was bled and its serum put up in small test tubes, according to Dreyer's method, against the emulsion of strain 11,693 in the following dilutions: 1 in 25, 1 in 50, 1 in 125, 1 in 500, 1 in 1,250 and 1 in 2,500. After three hours' incubation in a water bath, and allowing fifteen minutes for cooling, naked eye readings of the agglutinations were made, and the final reading for "end point" of sedimentation was made after twenty-four hours.

The highest dilution showing complete clumping and sedimentation of cocci in clear supernatant fluid was 1 in 250. Dilution of 1 in 500 showed only incomplete agglutination—i.e., a few flocculi of clumped organisms floating in slightly opalescent fluid. Dilutions of 1 in 1,250 and 1 in 2,500 entirely failed to agglutinate. Control tubes showed no agglutination.

The remaining five strains were all isolated from similar cases of quiescent or healed gunshot wounds in which a secondary operation undertaken for the removal of a sequestrum or foreign body was followed by a "flare" of sepsis. It is understood that the streptococci were isolated from the foreign bodies aseptically removed at the time of operation, and that the possibility of an extraneous origin of the organisms can be ruled out.

These strains were morphologically indistinguishable from strain 11,693 and their growth on glucose agar was alike, and typical of streptococci.

In all broth media, strain 11,292 resembled strain 11,693 by repeatedly, but not invariably, growing in ropy flocculi, sedimenting to the bottom of the tube, leaving the media above clear. The remaining four strains passed through many broth media, invariably caused a general cloudiness and opacity of the fluid. Hæmolytic tests were carried out as with strain 11,693.

Strains 11,292, 11,299, 11,700, 11,699, and 11,702 were classified as non-hæmolytic, since they caused no lysis of red blood cells in glucose agar, and only slight hæmolysis after two hours' incubation in contact with washed red corpuscles and subsequent standing for twenty-four hours at room temperature.

The fermentation tests compared with those of strain 11,693 gave identical results with all five strains; i.e., acid fermentation of lactose, saccharose and salicin. Acid and clot in milk for forty-eight hours. No reaction with mannite and inulin, and no reduction of neutral red. Agglutination tests indicate no great contrast between any of the six strains. All are agglutinated by a 1 in 250 dilution of serum of the rabbit immunized against strain 11,693. The agglutins for all the strains are entirely absorbed by emulsifying a twenty-four hours growth of strain 11,693 on five glucose agar slopes, with five cubic centimetres of a 1 in 10 dilution of its homologous serum, incubating the emulsion for three hours at 55° C., and allowing it to stand over the week end at room temperature.

TABLE I.—DILUTIONS OF SERUM OF RABBIT (1), IMMUNIZED AGAINST STRAIN 11693.

Strain	1/25	1/50	1/25	1/250	1/500	1/1,250	1/2,500	Control
11,693	+++	+++	+++	++	+	–	–	–
11,292	+++	++	++	+	–	–	–	–
11,299	+++	+++	+++	++	+	–	–	–
11,700	+++	+	+	+	–	–	–	–
11,702	+++	++	+	+	–	–	–	–
11,699	+++	+++	++	+	–	–	–	–

TABLE II.—DILUTIONS OF SERUM OF RABBIT (1), AFTER ABSORPTION OF AGGLUTININS TO STRAIN 11,693.

Strain	1/25	1/50	1/125	1/250	1/500	Control with unabsorbed serum 1/250
11,693	–	–	–	–	–	++
11,292	–	–	–	–	–	+
11,299	–	–	–	–	–	+
11,700	–	–	–	–	–	+
11,702	–	–	–	–	–	+
11,699	–	–	–	–	–	+

Moreover, it was found by repeated tests that all the agglutinins for the homologous strain 11,693 were completely absorbed by each of the five heterologous strains, after being twice in contact with the serum of the rabbit for two hours in the incubator at 55° C., and twenty-four hours at room temperature.

Table III indicates the extent to which the five heterologous strains, after first contact, absorbed agglutinins from the serum of a rabbit inoculated with strain 11,693.

TABLE III.—First Contact. Serum in Dilution of—

Heterologous strains	1/25	1/50	1/125	1/250
11,292	+	+	−	−
11,299	+	+	−	−
11,700	+	+	−	−
11,702	+	+	−	−
11,693	+	+	−	−
Control with homologous strain: 11,693	−	−	−	−

TABLE IV.—Second Contact.

Strains	1/25	1/50	1/125	1/250	Control with unabsorbed serum, 1/250
11,292	−	−	−	−	+
11,299	−	−	−	−	+
11,700	−	−	−	−	+
11.702	−	−	−	−	+
11,699	−	−	−	−	+
11,693	−	−	−	−	++

Note.—+++ Indicates complete agglutination and sedimentation.
++ ,, ,, ,, but no sedimentation.
+ Distinct agglutination, but some degree of opalescence remaining.

Table IV shows complete absorption of agglutinins for the homologous strain after the second contact with heterologous strains.

Summary.—(1) Streptococcus strain 11,693 corresponds to *Streptococcus pyogenes*, in that it is strongly hæmolytic and ferments lactose, salicin and saccharose and not mannite.

(2) The five other strains isolated from cases of latent sepsis give the same fermentations, but no hæmolysis. They closely resemble *Streptococcus mitis* (Holman).

(3) Agglutinating serum for the hæmolytic strain agglutinates the homologous strain in dilutions up to 1 in 500, and the five other non-hæmolytic heterologous strains, in dilutions up to 1 in 250, and since these strains when in contact with 11,693 agglutinating serum, absorb all the agglutinins of its homologous organism, it would appear that the strains 11,292, 11,299, 11,700, 11,699, and 11,702 are serologically indistinguishable.

(4) These streptococci—if we exclude the somewhat fleeting property of hæmolysis—have all the same biochemical reactions and morphological characters and therefore cannot be separated into varieties, and so long as their properties remain unaltered there is no apparent reason for using more than two strains—say hæmolytic strain 11,693 and one other—in the composition of a latent sepsis vaccine in which it may be desired to include this group.

Editorial.

Of late years, and during the war, there has been a tendency for articles contributed to the Journal of the Royal Army Medical Corps to deal mainly with problems of special interest to those officers who are more particularly concerned with research into the causation and prevention of disease incident to the troops.

While such contributions must be of the greatest importance if the Journal is to maintain its present position, it is held that the period following upon the close of a war of the magnitude of that now at an end affords an opportunity for attempting to widen the scope of the Journal by inviting contributions for publication dealing with every aspect of military medical service in all parts of the globe. Before long, diaries will be lost, recollections will become dim or distorted, and an unique occasion for making a permanent record of facts and impressions will have passed away.

The Editor therefore will be glad to receive articles dealing with any of the undermentioned subjects:—

(1) Summaries and analyses by specialists of investigations and research in the ætiology, incidence, diagnosis and treatment of diseases or wounds, and in the sciences allied to medicine.

(2) Administration and organization of the medical services in peace and war.

(3) Administration, organization and equipment of front lines, lines of communication, and base medical units, and of hospitals and convalescent hospitals at home.

(4) Organization and administration of the sanitary services in peace and war.

(5) Descriptive articles on various theatres of war and stations abroad, including such matters as topography, climatology, ethnology, geology, natural fauna and flora, inhabitants and customs.

(6) Narratives of experiences of individual officers in various theatres of war.

(7) Experiences of individual officers on recruiting and travelling medical boards.

(8) Organization of physical training and recreation.

(9) The control of venereal diseases.

(10) The relations of the military and civil medical services in peace and war.

Clinical and other Notes.

IMPROVISED AMBULANCE TRAINS.

By Brevet Major R. W. D. LESLIE.
Royal Army Medical Corps.

At a time of pressure, when the fully equipped ambulance trains at an English port were unable to cope with the large numbers of sick and wounded arriving in the United Kingdom from overseas, and even ordinary stock was none too plentiful, some extemporized means of converting luggage vans or milk vans into vehicles for carrying stretcher cases had to be considered.

An ingenious arrangement of iron stanchions, with bars to support stretchers in three tiers, which could be erected comparatively easily and quickly, was acquired from mobilization stores. In practice, however, this device was found to possess many disadvantages, as it was exceedingly difficult to load the cases; actually fewer patients could be accommodated by this method than by simply placing them on the floor: and further, owing to the formation of the stanchions and bars, the movements of the coach were amplified to such an extent that the patients suffered very much from the resulting oscillation.

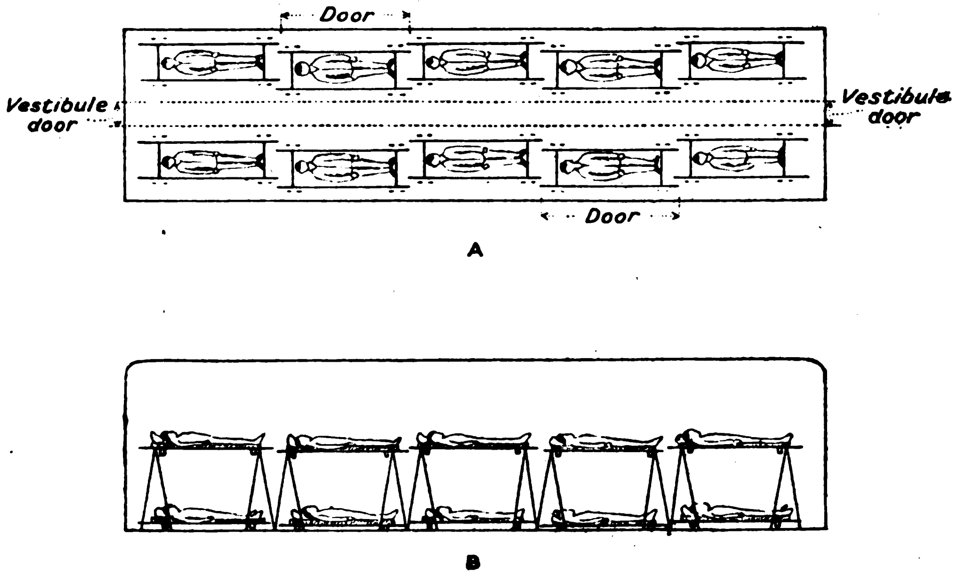


Fig. 1.—Diagram of van, equipped with trestles to carry twenty cases. A, Plan, with top stretchers removed, showing bottom stretchers in position, also position of the feet of the trestles, and dovetailing of the stretcher poles. B, Elevation, showing arrangements of trestles and stretchers at one side.

Of the various improvisations laid down in manuals, including the classic "Zavodovski's method," all were found to possess drawbacks, chiefly in connexion with loading, which precluded their adoption. Very few of the

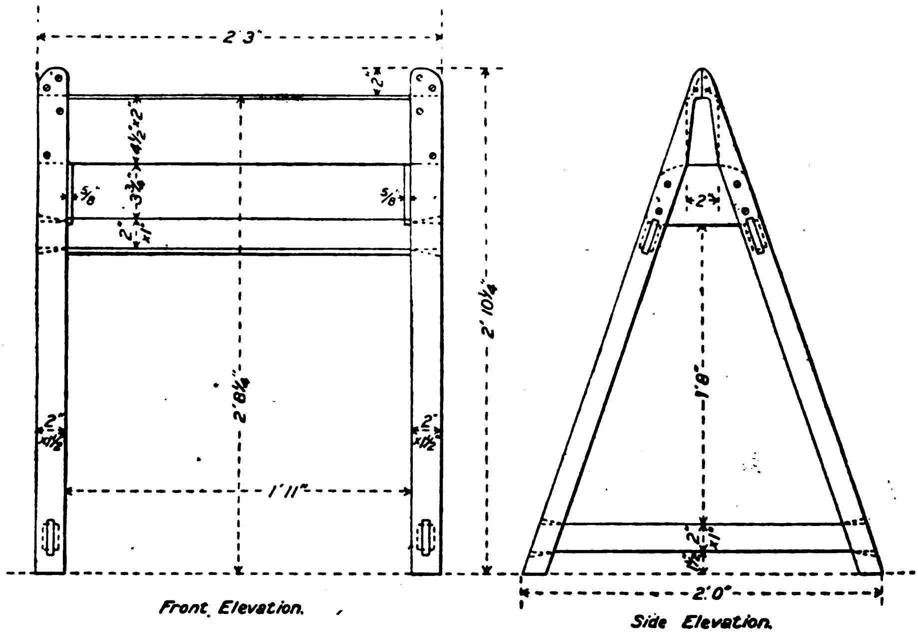


FIG. 2.—Plan of trestle.

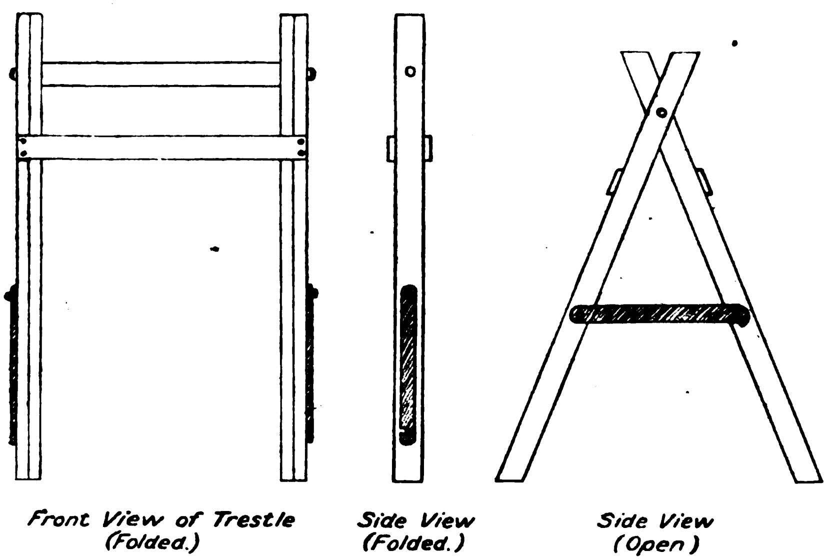


FIG. 3.—Plan of folding trestle.

methods made full use of available space, and many required structural alterations or metal fittings which were not procurable.

After some experiments, carried out in conjunction with the railway company, the trestles described in this article were evolved, and a thorough test extending over a period of nearly two years has fully established their practical value. From an economical point of view, it is difficult to conceive anything better. Their chief advantages are that they enable loading to be done with almost the same speed and ease as in ordinary ambulance trains; full use is made of available space, and apart from the trestles themselves, no metal fittings or structural alterations are required. They remain perfectly steady at all speeds, without any fixture beyond the lower stretcher, which, as may be seen in fig. 1, lies between the feet of each pair of trestles and acts as a "stop."

FIG. 4.—Part of the interior of a milk van, fitted with trestles and stretchers provided with blankets. Arrangements for heating and lighting may be noted overhead.

The structure of the trestles is comparatively simple (see fig. 2). They are built entirely of wood, and are light enough to enable a bearer to carry a pair easily. To facilitate packing for transport, the trestles can be made to fold as in fig. 3.

Loading by means of these trestles is comparatively simple. As many patients on stretchers as can be accommodated are placed end to end along the floor of a van, leaving a gangway in the centre and a space for entrance and exit: by dovetailing the handles of the stretchers no room is lost (see fig. 1 A). Trestles are now carried into the van, and a pair placed over each of the patients on the floor. The upper patients are then brought in and placed on the trestles. The upper stretcher should be arranged so that the cross bars of the trestles support it just

outside the feet (see fig. 1 B). The loading of the last two cases is done by bringing the upper in first and placing it in the gangway; the lower case is then put in the space left for entrance, a pair of trestles arranged over it, and the upper case lifted from the gangway into position on them.

When unloading, the two patients opposite the door are removed first, by placing the upper case in the gangway. The lower case is then removed with its trestles, followed by the upper case; after which unloading is completed by clearing the remaining upper patients and finally the lower.

If spare stretchers and mattresses are available they can be arranged beforehand, and patients may then be carried in and transferred from their stretchers into those in the van, as though into the berth of an ordinary ambulance train; the last two cases being loaded outside and finally arranged as explained above.

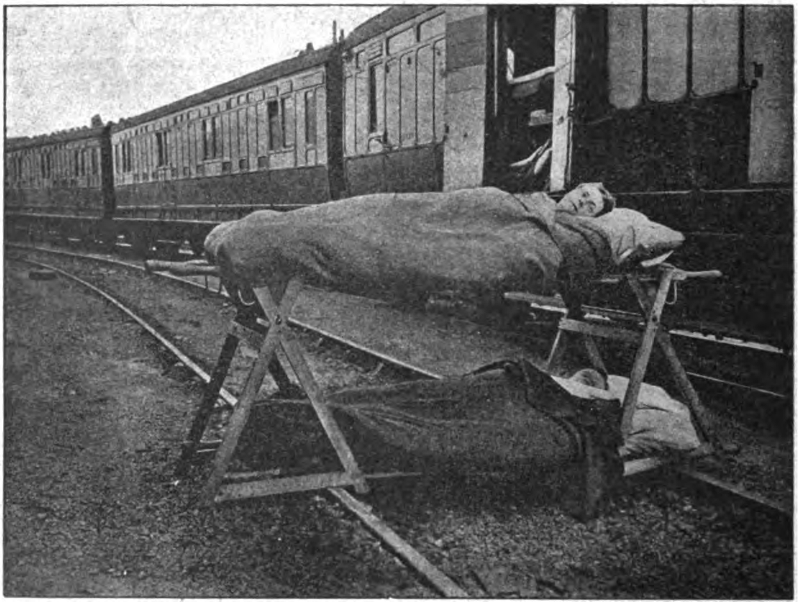


FIG. 5.—Exterior of a van train. The last two stretchers with their pair of trestles are shown, prior to being loaded.

Vestibuled vans, fitted with trestles to carry twenty cases, have transported thousands of sick and wounded, and are employed daily, either attached, singly, to equipped ambulance trains, or made up into complete emergency trains. When mattresses are used with the stretchers there is little to choose in smooth travelling between these so-called "van trains" and the fully equipped ones.

The use of these trestles might be extended to temporary hospitals when floor space is limited, as it is possible by their employment to accommodate two patients in the space usually occupied by one.

The photographs illustrating this article were kindly provided by Captain J. G. F. Hosken, R.A.M.C. (T.), and the diagrams by Pte. D. Wilson, R.A.M.C.

AMŒBIC DYSENTERY.

The Use of Silver Nitrate Irrigations for the Diagnosis of Doubtful Cases of Chronic Diarrhœa.

By Captain T. O. THOMPSON.
Royal Army Medical Corps.

The following account may be of interest and of some use to others who have also to deal with cases of chronic diarrhœa, in which, although no amœbic or bacillary infection can be found, the diagnosis is probably amœbic dysentery.

In 1919 I had, amongst true dysentery patients, several cases in which everything pointed to the probability of amœbic dysentery infection, but at no time after prolonged and repeated examinations could *Entamœba histolytica* be found either in the free or encysted forms. In spite of courses of treatment with emetine, ipecacuanha, bismuth, and salol, aperients and astringents, these cases did not improve, the general health remained poor, and a moderate diarrhœa persisted.

Therefore, with a view to treatment in the first two or three cases, irrigations with silver nitrate were given. In each case there was a marked improvement, generally after the second or third day; the patient became free from the constant pain in the left iliac fossa, and from the constant desire for and straining at stool. But the point which was most striking, and for which these notes are given, was that the daily examination of stools showed *E. histolytica* to be present on the second to the sixth day after the commencement of the irrigations in each case.

Thus the diagnosis was definitely settled, and treatment could subsequently be directed in the correct channels.

The cases are as follows:—

Case 1.—Lieutenant A. had been in hospital almost continuously from October, 1918, to May, 1919, only leaving hospital for a few weeks. He had been placed under arrest for neglect of duty, and was suspected of "malingering" or "doping," even at the court martial. He was again sent to hospital. He was pale and washed out, with a constantly furred tongue and foul breath. He complained of great lassitude, intermittent pain in the abdomen, particularly in the left hypochondrium, and an intermittent diarrhœa with tenesmus.

For months examinations of his stools were made four times weekly with negative results.

He had altogether four courses of emetine, each course being six daily doses of $\frac{2}{3}$ grain. He had also had a variety of other treatments without any success.

As the condition appeared to be getting worse, irrigations of silver nitrate were commenced: Silver nitrate 1 drachm in 1 ounce of water was made up with 2 pints of warm water, and given as a high irrigation, being retained for about ten minutes. The patient stated that he could feel it right up across the upper part of the abdomen. The relief was great, and the irrigations were continued daily with marked improvement in his general condition.

On examination on the third day, i.e., the second motion after the first irrigation, *E. histolytica* were found in the stools, and thus the whole illness shown to be due to this.

With a prolonged course of emetine, combined with an ipecacuanha mixture,

a marked improvement set in. Bismuth-emetine-iodide was not available for these cases.

Case 2.—Captain B. had been in hospital twice in Mesopotamia with diarrhœa. He had been given two injections of emetine on one occasion only. On admission, he had had diarrhœa for some weeks, and repeated examination of stools had failed to show any cause. He had been treated in hospital in various ways, and had had one full course of emetine, in spite of which this low condition persisted, but no amœbæ could be found. He was put on high irrigations, with ½ per cent. silver nitrate solution, and the third day's examination of stools showed *E. histolytica* cysts present.

In the stools were small masses, or, rather, patches, of cell debris and very solid mucus, with one side smooth and firm, and the other side ragged. These were not patches of epithelium, but merely cell and pustular debris bound together.

Case 3.—Lieutenant C. had commenced diarrhœa in Mesopotamia, and had had it off and on for three and a half months. On admission, no treatment was given beyond dieting for two weeks, during which daily examination of stools gave a negative result. He was put on high silver nitrate irrigations one grain to one ounce, and the fourth day's examination showed numbers of free forms of histolytica and the same type of patches of cell debris. He had had definite areas of tenderness above the umbilicus and on the course of the descending colon. This tenderness rapidly disappeared after the institution of the irrigations.

Case 4.—Pte. D. had had chronic diarrhœa for two and a half years, and had been in hospital four times and twice had had a course of emetine. No amœbæ had ever been found in his stools, but lamblia and blastocystis had been constantly reported, and the case was thought to be a chronic colitis due to lamblia infection. He was put on high silver nitrate irrigations, and the seventh examination showed histolytica present.

Case 5.—Captain E. complained of constantly recurring pain in the epigastrium after meals, but never any vomiting or other symptoms of gastric ulcer. On examination there was constantly a tender area just above the umbilicus and 1½ in. to the right of the middle line. He had no diarrhœa, nor had he any noticeable attack during three years in Mesopotamia.

He was given high silver nitrate irrigations with a gradual disappearance of the pain, and on the third examination of stools *E. histolytica* were found in fair numbers.

Case 6.—Major F. had had chronic diarrhœa for three years; many tests had been negative; he had passed through many hands and had many treatments, and many periods of sick leave.

During a recurrence of this condition he was admitted; he was put on ½ per cent. silver nitrate solution irrigations, and on the fourth day histolytica cysts were found in the stools together with the cell debris patches mentioned previously.

Case 7.—Assistant Surgeon G. had had many bad attacks of malaria in East Africa and was returned to India. He appeared to have recovered from the malarial attacks, but for months did not feel really fit. While on sick leave he had slight diarrhœa. His stools contained mucus every time, but prolonged and careful search for many days failed to show any amœbæ, and the plating gave negative results for bacillary infection.

He had two courses of six doses each of emetine hypodermically. He was then seen by a medical board, who sent him for an opinion as to the probable pathological cause, as nothing definite had been found. High irrigations of silver nitrate solution ¼ per cent. strength were advised, as there appeared to be every probability of *E. histolytica* being the cause.

The next day's examination, i.e., the first stool after the irrigation, showed masses of young free *E. histolytica* in parts of the stool and showed again the same toughened patches of cell debris and mucus.

In consideration of the above quoted cases, it appears that high irrigation with silver nitrate does definitely help in the diagnosis of cases of chronic diarrhœa or colitis which are suspected of being due to histolytica. Cases 1, 4 and 6 had been tried previously on high irrigations with other solutions, i.e., boric lotion and weak eusol solutions. They also had had enemata fairly frequently. But they still gave negative results for amœbæ until the silver nitrate irrigations were tried.

From this and the presence of these toughened patches of mucus and cell debris, it appeared to me that the action of the silver nitrate was to coagulate the masses of mucus and debris which can be found covering the surface of a dysenteric ulcer; and that this coagulation of each mass loosened its edges and freed it from the edge of the ulcer, and that then the whole patch could be washed off the ulcer by the liquid. Thus the actual ulcer itself is exposed and the amœbæ which are present can escape or be washed into the lumen of the gut and pass into the fæces during the next few days. This, of course, is mere supposition, and whether this is the mode of action or not I cannot say; but to my mind there is no doubt that in obscure chronic cases of diarrhœa or colitis high irrigations with silver nitrate solution do bring to light the causative agent when this is *E. histolytica*.

This method appears to be particularly applicable to those cases where there is little or no diarrhœa, no present or past history of hæmorrhage, and very little to go on except a constant abdominal discomfort, and pain and tenderness in one or two definite areas. In other words, the type of case which probably has one or two well-marked, fairly deep ulcers which are well covered over and which cause constant irritation and slight diarrhœa, but do not discharge any amœbæ into the gut, and hence to the fæces.

It is in such cases that the silver nitrate appears to have its coagulating and loosening effects, and thus exposes the cause of the condition.

I admit that my experience is very small indeed, being only some two dozen cases in all. I should, therefore, be much interested to learn the experiences of any others who may try this method in such cases out of the large number of obscure, semi-chronic diarrhœa cases which are constantly occurring.

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DIRECT TRANSFUSION OF BLOOD.

LIEUTENANT-COLONEL A. J. HULL.
Royal Army Medical Corps.

ALTHOUGH the advantages of direct transfusion are so apparent, this treatment does not appear to be in such frequent use as it would merit.

Apart from its obvious indication in cases of severe hæmorrhage, it would appear to be a valuable treatment for severe sepsis and shock. The delivery of healthy blood to patients suffering from septicæmia must provide them with the bactericidal agents, bacteriolysins, antibodies, agglutinins, opsonins, leucocytes, and tryptic power, of which they are deficient.

How far the alteration of the blood in cases of shock determines the result is at present uncertain, but the effect of healthy blood upon the tissues of such patients appears to be worthy of consideration.

Transfusion would appear to be a more scientific remedy than the empirical injection of antiseptics into the blood-stream.

The difficulty of obtaining someone willing to submit to an operation entailing ligature of an artery is, in my opinion, the only bar to a much greater use of this treatment.

The operation is very simple, and can be performed without the use of special apparatus—in fact, I consider the use of any apparatus most undesirable.

To be efficient and certain in its results the operation should be performed by the direct transfusion of blood from artery to vein. It is only in this way that clotting, the one danger of transfusion, can be avoided with certainty.

The only disadvantage of this method is that the amount of blood transfused cannot be measured, but this is outweighed by the safety and simplicity of the method, and, moreover, the amount of blood which flows before the donor becomes faint is fairly constant.

Position of the Patient and Donor.—The left hand of donor grasps the arm of the patient just above the elbow, bringing the donor's radial artery in close proximity to the patient's median-basilic vein.

The Operation.—An incision about two inches in length is made in the patient's arm over the median-basilic vein.

The Preparation of the Artery.—A similar incision is made over the radial artery of the donor—the artery is cleaned for about an inch; the lower end of the artery in the wound is clipped. Digital pressure is made over the brachial artery, and the radial is cut above the clip.

The end of the radial artery is pulled out of the wound, and a traction suture is tied through the wall of the artery.

The next step is *the preparation of the vein.* Two probes about an inch apart are passed under the vein for hæmostatic reasons—a small cut is made into the vein (two millimetres in length), through this the needle bearing the traction ligature from the radial artery is passed. The needle emerges from the vein an inch above the incision, a second suture is now passed through the wound in the vein; this suture is used to close the vein when the artery has been inserted. By drawing upon the traction suture the artery is drawn into the vein, the vein suture is tied, and the probes and digital pressure removed.

The blood is allowed to flow until the donor feels faint. The artery is then clipped, pulled out, and ligatured. The whole procedure is carried out under local analgesia.

It may be objected that making use of the radial artery as a canula involves a serious and avoidable mutilation upon the donor; this is not the case—ligature of the radial artery must be performed in any case, and the excision of an inch or so of the vessel makes no difference. The elasticity of the artery renders its use as a canula easy, and a considerable length of vessel becomes available through a comparatively small wound.

THE PROBLEM OF BILHARZIASIS IN SOUTH AFRICA.

By F. G. CAWSTON, M.D.Cantab.
(*First Streatfield Research Scholar.*)

The report of some experiments by Mizaira and Suzuki to determine the life-history of the parasite which causes the Asiatic form of Bilharzia disease was reviewed in the *Tropical Diseases Bulletin* for March 30, 1914, and referred to redia-produced cercariæ in the hepatic ducts of infested snails.

In 1916 Dr. Juan Iturbe published for the National Academy of Medicine in Venezuela an illustrated paper on the Intermediate Host of *Schistosoma mansoni*, in which he describes undoubted redia-formation. It is a little difficult to understand that the same species of trematode worm should be sporocyst-produced in one part of the world and redia-produced in another; but observations of the development of closely allied species would seem to show that such a thing is not altogether improbable.

The report by Lieutenant-Colonel Leiper of the Bilharzia Mission to Egypt which appeared in the Journal of the Royal Army Medical Corps for 1915 includes a description of Bilharzia-infested snails producing the Egyptian forms of the disease. These cercariæ are said to develop in sporocyst and daughter sporocysts, and no mention is made of redia-formation in the life cycle of the Bilharzia parasites in Egypt.

Schistosoma hæmatobium, which is responsible for Bilharzia disease in South Africa, develops in sporocysts in the liver-substance or nephritic ducts of *Physopsis africana*. In some instances a few isolated cercariæ may be found in the liver-substance and the liver entirely free from sporocyst-formation. In such cases one has to look in the nephritic and genitary region of the snail before one comes across the sporocyst that produces them. The cercariæ develop to their full size in the sporocyst and, at whichever stage of infection one examines the snail, there is no trace of redia-formation, except in mixed infections. Dr. J. G. Becker, who reported adult Bilharzia worms in a guinea-pig to which he had given these cercariæ from *P. africana*, decribes the cercariæ in the *Medical Journal for South Africa*, April 1916, but makes no mention of redia-formation in the infested snails.

P. africana is one of the commonest fresh-water snails of semi-stagnant water in infested areas. I have never found any redia-formation in infested specimens from Magaliesburg, Rustenburg, Mulder's Drift, Umbilo, Toll Gate and the Umsindusi river at Maritzburg.

There are several closely allied Schistosomes in the infected areas of Transvaal and Natal, suggesting that more than one species may affect man and animals; although the presence of Schistosome infection has not yet been recorded in animals in South Africa. Through the assistance of the Streatfield Research Fund of the Royal College of Physicians, I am carrying out experiments at Durban to determine the life-cycles of the whole Schistosome group of parasites, which are present in various species of fresh-water snails.

Cercaria Secobii.

In 1916 I found a narrower Schistosome with long prongs to its divided tail in ninety-nine *Physopsis* from Maritzburg. Dr. E. E. Warren suspects this is an avian trematode. Sporocysts in various stages of development were present in the livers, but no trace of redia-formation.

Cercaria Crispa.

During the first nine months of 1919 I found eighty *Physopsis* in the district around Durban infested with a Schistosome resembling the Bilharzia but having rather longer prongs. These prongs have a distinct tendency to curl over towards the tail. None of the infested snails showed redia-formation.

Cercaria Gladii.

In 1917, I found a Schistosome at Potchefstroom which was redia-produced. It had prongs resembling drawn swords and infested *Isidora schackoi*. In one infested specimen the rediæ were found in the liver-substance having a distinct movement of their own. They possessed pharynx and gut, and fully developed cercariæ were seen inside the rediæ. In another infested *Isidora*, although the cercariæ were mature, no rediæ were seen.

Cercaria Parvoculata.

P. africana in the Durban suburbs is infested with an eye-spotted furcocercaria, developing in bottle-shaped rediæ showing pharynx and gut. These rediæ are uniformly about the same length. One infested liver contained a mass of them. They are 1·30 millimetres in length. The pair of round eye-spots which are situated near the middle of the head of the cercaria are faintly visible through the semi-transparent walls of the pigmented rediæ. This cercaria, which is 0·77 millimetres in total length, is the only furcocercous form developing in rediæ that I have isolated from *P. africana*.

Cercaria Pigmentosa.

Redia-formation is not at all uncommon with the leptocercariæ of Natal and the Transvaal or with the amphistomes. *C. pigmentosa*, which develops into liver-flukes when given to animals on lettuce, develops in large rediæ in the liver-substance and nephritic ducts of *Limnæa natalensis*, our commonest fresh-water snail. These rediæ are often as much as $\frac{3}{8}$ of an inch in length.

In April last the Officer Commanding the Military Convalescent Camps in Durban, Captain Birkett, South African Medical Corps, requested me to treat a lieutenant who was a Bilharzia carrier and suffering from renal stone. I commenced a series of tartar emetic injections on April 2, when his urine contained the characteristic spine-pointed ova. By April 10, all ova had disappeared from his

urine and they have not reappeared. On October 11, this patient told me he had had no return of his hæmaturia, though he was still being treated for renal calculus. Microscopic examination of his centrifugalized urine showed absence of ova.

The other cases that I have had under treatment by tartar emetic injections have all shown improvement or cure; but many that have recovered from the direct effects of the parasite are still suffering, as the above case is suffering, from complications arising from the disease.

In one case, where the ova have disappeared from the urine for several years, the patient is still subject to recurrent hæmorrhage from a papillomatous growth of the neck of the bladder which has recurred after successful removal a year ago.

Another is suffering from a severe cystitis of several years' duration, apparently caused by the presence in the urine of staphylococci, which do not respond to autogenous vaccines.

In another case, although the ova have disappeared for several years, an intractable *Bacillus coli* infection remains.

A NOTE ON DERMATOPHILUS PENETRANS.

By Captain MALCOLM E. MacGREGOR.
Royal Army Medical Corps.

The Chigger Flea (*Dermatophilus penetrans*), during the recent campaign in East Africa has been a positive scourge iu certain localities. As there is an obvious scarcity of practical knowledge in the available literature on this flea a few notes may be useful.

The distribution of the parasite in Africa is very extensive. It occurs on the Western and Eastern sides of the continent, around the Great Lakes, and here and there right across the continent. It has also spread across to Madagascar, and, by the movements of the troops no doubt, will have been found to have been carried into many parts of Africa hitherto free from the pests; particularly towards the South.

As is well known, Chiggers flourish best in warm, dry sandy places, so that the coastal line of Africa is admirably suited to them.

I first made personal acquaintance with these parasites soon after landing on the East coast, and have ever since looked upon them as an enemy not to be regarded with contempt.

When the British forces landed at Lumbo on the mainland coast opposite the island of Moçambique, in Portuguese East Africa, the Base Hospital encamped at the edge of the low cliffs on the sea-shore, and hospital tents and officers' quarters consisted of E.P. tents and marquees. The ground was of a sandy nature, but contained enough humus to support a scanty vegetation and the ubiquitous cocoanut palms.

Lumbo was free from Chiggers, as far as I can ascertain, until a few weeks after the landing of the troops. Anyhow, we lived comfortably free from attack for some weeks after we got established.

In the meantime large numbers of Ascaris, native porters and white troops had been landed and had encamped over a wide area. Among these troops there

were certainly some who brought in the pest with them, for within a few weeks there were quite a number of men reporting for treatment.

One night, soon after I had retired to bed, I noticed an intolerable irritation of my toes. I threw back the sheets, and with a Deitz lamp examined the lower end of the bed as best I could while under a mosquito-net. I could see nothing that I thought might account for the trouble, and I suspected that my native servant, or "boy," had probably aired the bed-clothes that morning as usual and had carelessly spread them on some bush where the "buffalo" or "velvet" bean grew. The hairy covering of this bean is easily rubbed off and produces severe cutaneous irritation.

In the morning I noticed that the skin around the toes looked slightly reddened and I lectured my "boy" on his supposed stupidity. The irritation had ceased, however, and until a few days later the incident was forgotten. Some four or five days afterwards I had been on a long march one afternoon and noticed that the second toe of my right foot was painful on my return. I put this down to pressure due to a not too well fitting boot, but during the night the pain was severe and the toe throbbed. Thinking that I must have got it infected in some way, I was just about to put on a light pair of socks after my bath in the morning to give more room to the toe in the boot, when my "boy" noticed the trouble and examined the foot. He complacently remarked "du-du" (the Swaheli for "insect"), and asked for a needle.

I realized then, with a feeling of disgust, that I had become a victim of the Chigger-flea.

My "boy" operated upon the toe and removed six parasites from various parts of the foot around the toes. The parasite that had caused the discomfort was fully developed, and the rest were in different stages of gestation.

When the operation was over, and the sites had been treated with iodine, I said to myself, "Never again, if I can help it," and determined on stringent prophylaxis. My tent-companions were somewhat amused at the incident and my misfortune, so I retorted "Have your own feet examined!" Somewhat to my consolation and own amusement it was found that they too were the victims of this pest, and the discovery produced consternation in the erstwhile humorists.

Recollecting the night of my disturbance in bed, I remembered that I had half consciously noted a few barely visible animated black dots on the white sheets, which I had brushed off. Not thinking of *Dermatophilus*, or then realizing that these parasites would actually enter one's bed, I had regarded them as some species of the hosts of micro-insecta that swarm everywhere in the tropics and are negligible. Undoubtedly, however, these black dots had been invading *Dermatophilus* and the irritation of the toes was due to their attack.

Dermatophilus will bite and parasitize both during the day and night, but these parasites are far more nocturnal than diurnal in their activities, and one's chance of becoming a host is almost nil in the day time compared with what it is in the early hours of the evening and the hours of darkness. This fact I found is well known to the East African natives.

During my stay at Lumbo after this, *Dermatophilus* became a severe pest. However, I was never again troubled, by adopting the following simple precautions: After my bath *in the late afternoon* each day I rubbed into the toes and soles of the feet a little toilet vaseline, and then put on a pair of thick woollen socks. As

an additional precaution, a little Keating's insect powder was sprinkled into my mosquito-boots. My "boy" was instructed to air my bed-clothes in the sun each day, supporting them on a cord well above the ground, and when making the bed later on in the day to dust a little Keating's between the sheets at the lower end of the bed.

The value and success of these measures was well proved even in my own tent, because at first my tent-companions would not be bothered altering their routine. They were repeatedly victimized, until they became at length sadder and wiser men. By adopting the same proyhylaxis they acquired complete protection also.

Even a fully developed *Dermatophilus* in the human skin may be easily overlooked. In the white human skin, however, the parasite may be recognized by a typical area. There is a small black dot surrounded by a circular blanched area of skin, which is again surrounded by a small margin of inflammation. The site under which the parasite lies is often not raised above the normal skin level.

To remove the parasites, use only a moderately sharp-pointed instrument, such as a clean blunt pin, or there is danger that the body of the insect will be pierced, leading to a greater chance of septic infection.

Remember that the parasite is encapsulated only, and is not adherent to the skin at all. Commence by gently introducing the point of the blunt pin into the central black dot. Clear the skin back all the way round until the parasite can be seen within, and until at last the pin may be thrust behind it, and the parasite cleanly enucleated. In this way only a small cavity is left in the skin, with little or no resultant bleeding, or likelihood of sepsis. The area should be treated antiseptically, however, after the parasite is removed.

The parasites that have been removed should be burnt, or there is danger that some of their eggs may hatch and give rise to a new generation.

I was interested to see that the natives of East Africa were alive to this danger, and it is the custom to screw each parasite up in a small piece of paper and set it on fire.

Occasionally cases were seen where the parasites had entered the skin around the fingers. These cases were all among drivers in the Mechanical Transport, and were accounted for in the fact that the drivers had often to get down on their hands and knees in the dust to attend to their vehicles.

The natives believe that it is only at night that infestation takes place, and they are, in the main, right in this belief I am sure. Also they maintain that only during the dry, rainless days are the parasites active and that rain and wet weather banish them for the time being. Another observation that I am inclined to support.

Report.

ON THE ANTI-MALARIA CAMPAIGN AT TARANTO DURING 1918.

By Colonel J. C. ROBERTSON, C.M.G., C.I.E., M.B., C.M.
Indian Medical Service.
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General.

(1) When it was first decided that Taranto must be used as the site of a large rest camp on the line of communication with the East, it was well known that the district was a highly malarious one, and that that disease was likely to prove a serious menace to the health, not only of the troops stationed in the camp, but also of the much larger numbers passing through. A site the least likely to prove dangerous was therefore chosen, and arrangements were made for all the usual anti-malaria operations to be brought into force. Mosquito nets were issued, daily prophylactic doses of quinine were given to the troops, surface collections of water were searched for mosquito larvæ, and were oiled or drained, and all wells in camp found to be infected were either sprayed with oil or closed down altogether. Each of these measures is useful, and their total effect must have been to reduce the number of infections amongst the troops considerably. At the same time, they were far from being sufficiently thorough or extensive to deal effectively with the danger, and malaria infections still took place quite freely. Apparently, however, the precautions which were being taken engendered a false sense of security, while, at the same time, the damage being done was masked by faulty reporting of cases, so that it was not till late in the autumn of 1917, when reports came in from Egypt and Salonika regarding the arrival of badly infected troops at these places, that the full gravity of the position began to be recognized.

Prevalence of Malaria during 1917.

(2) It is impossible now to gauge accurately how great the damage to the troops by malaria infection at Taranto during 1917 really was, as sufficiently careful and complete statistics were not kept. Some information regarding what actually occurred during that period is, however, necessary, not only to justify the expenditure on the campaign of 1918, but also to measure the degree of success which has been attained. With this object in view, inquiries were started, but most of the information available was too open to fallacies to be of any value and had to be discarded. Certain facts and figures have been collected, however, which are more definite. These are given in the following paragraphs, and, though somewhat isolated and incomplete, they serve to form a picture of the real conditions as regards malaria prevalence in Taranto during 1917, which is useful.

Hospital Admissions for Malaria in 1917.

(3) The faulty reporting of cases of malaria during 1917 has already been referred to. This, apparently, was due, partly to inexperience of the disease on the part of the medical staff, but chiefly to an instruction that no patient was to

be diagnosed malaria unless the parasite had actually been found in his blood. Many cases, though they were treated as malarias and reacted at once to quinine, were labelled P.U.O., diarrhœa, sand-fly fever, influenza, etc., solely because no examination of their blood had been possible, or because the one examination which was performed had proved negative. Any statistics, therefore, compiled from the hospital admission and discharge books, would give a very false impression of the malaria conditions that existed. But a full and careful investigation has been made by Captain O. R. Belcher, R.A.M.C., of all fever cases, more especially those marked P.U.O. or N.Y.D., admitted to 79 General Hospital from amongst the white troops forming the permanent staff of the camp between June, 1917, and April, 1918. His figures and revised diagnoses I have since carefully scrutinized, discarding any case in which there could be any reasonable doubt as to the disease. From this investigation, the following interesting results have been obtained.

The white troops of the permanent staff gradually increased from three officers and five other ranks on May 18, 1917, to 105 officers and 1,468 other ranks on October 31, of the same year. The approximate white population exposed to infection during the autumn of 1917 was, therefore, 1,573. From amongst these there were 220 primary admissions to hospital due to malaria, of whom 28 had ultimately to be evacuated to England as permanently unfit, and 6 died in Taranto. This gives a known malaria infection rate of fourteen per cent and a wastage rate of 2·2 : the actuals were probably somewhat greater.

Malaria Histories of Units in 1917.

(4) Early in 1918 an attempt was made to trace the history, as regards malaria during the previous autumn, of some of the white troops stationed in the camp. For various reasons this was not possible in many cases, but the accounts of three detachments, one of which arrived early, and two late, in the season, are of interest as indicating the malaria conditions which then existed.

(*a*) A labour detachment of 101 men arrived in camp on May 21, 1917. Excluding one man, whose history is not quite certain, thirty-two of the remainder had been admitted to hospital for malaria before November 15. This gives a definite infection rate of thirty-one per cent, and if four others, who developed the disease later, are included, the very high rate of thirty-five per cent.

(*b*) Another labour detachment of ninety-six men arrived on September 17, 1917. Before the end of the year, five of these had developed malaria, and the number had increased to nine by the end of the following March. This gives an infection rate of just over nine per cent, which is also very high, considering the late arrival of these men.

(*c*) On September 21, 1917, a draft of thirty-one men arrived to join the Sanitary Section. From these six must be excluded four because they were posted to out-stations for varying periods, and two who were admitted to hospital immediately after arrival and were later invalided for other diseases. Of the remaining twenty-five, six developed malaria before the end of the year, and one early in 1918—an infection rate of twenty-five per cent.

In each of these cases, the incidence of infection was high, and in the last exceptionally so.

STATEMENT OF PATIENTS.

(5) Many statements which are of interest in this connexion were obtained in the course of investigations into the origin of primary attacks of malaria early in 1918. These statements were followed up and verified as far as possible, and those cited below may be taken as quite accurate on the whole.

(*a*) Pte. G. Gattenby, 196 Labour Company, had never been out of England till he came to Taranto in May, 1917, slept in a bell tent with nine others till September, took prophylactic quinine regularly—of the nine others two also had malaria and one was invalided to England.

(*b*) Cpl. G. H. Hageman, 196 Labour Company, had never been out of England till sent to Taranto in May, 1917, lived in a tent with two others, had a mosquito net but rarely used it as was not troubled by mosquitoes, took quinine regularly; the two others in same tent also got malaria and one died.

(*c*) Staff-Serj. T. Oates, R.E., went to France in July, 1915, then to Taranto in June, 1917, never had been away from England before, occupied tent with two others, each had a net which he used regularly, took quinine daily, did not notice mosquitoes much himself, though the others got bitten a good deal and they killed plenty in the mornings, full of blood; both the others got malaria and one was evacuated to England.

(*d*) Company Serj.-Major S. Aspin, 196 Labour Company, left England in May, 1917, for Taranto, had never been away before, lived in bell tent with one other, had mosquito nets and used them regularly, took quinine daily, there were lots of mosquitoes and he was much bitten; other occupant of tent also got malaria and was invalided.

(*e*) Serjt. T. Wheeler, R. E., arrived in Taranto in June, 1917, had never been out of England before, took quinine regularly but did not use net; there was one other occupant of tent who also got malaria and was invalided.

(*f*) Pte. C. W. Reeves, 196 Labour Company, came to Taranto in May, 1917, first time out of England, in bell tent with seven others, all took quinine regularly but seldom used nets except against flies in day-time, was not troubled by mosquitoes; only one other in tent got malaria.

(*g*) Pte. H. Snape, 196 Labour Company, came to Taranto in May, 1917, never been out of England before, except to France, slept in bell tent with seven others, had nets but did not use them every night, took quinine regularly, saw and killed many mosquitoes especially in mornings, was once excused duty for ten days for septic bites on arms, remembered names of only three of others in tent, of these one had been to India and had had fever and ague there, one had malaria in Taranto, and was invalided while the third never had fever.

(*h*) Lance-Cpl. S. Ralph, R.E., came to Taranto in May, 1917, never been away from England except to France, slept in tent with three others, took quinine regularly but did not use nets, plenty of mosquitoes but they did not bite him; two other occupants of tent also got malaria and one was invalided.

These are not selected cases but are taken in order from amongst those first inquired into, and later cases were a repetition more or less of the same story. In trying to place a true value on this evidence of the conditions in camp as regards malaria during 1917, however, it must be remembered that malaria is largely a

place infection, and groups of cases tend to occur in the same tent or hut; the conditions noted above must be interpreted in a very general fashion and on no account be taken as representative of those in the tents and huts as a whole, or a very exaggerated notion of the prevalence of the disease would be formed.

Infection amongst Transit Troops.

(6) Towards the end of 1917 certain reports were received from Egypt regarding malaria infection amongst the troops arriving there. These are the reports already referred to as first attracting notice to the conditions at Taranto. They may be summarized as follows:—

(*a*) On October 3, 1917, H.M.T. "Snaefell" sailed for Egypt with twenty-four officers and 396 other ranks whose average length of stay in Taranto had been thirty-four days. On arrival on October 8, one man was transferred direct to hospital and subsequently died of cerebral malaria. Shortly after disembarkation eleven others were admitted to hospital with the same disease.

(*b*) On October 7, 1917, H.M.T. "Aragon" left with 198 officers and 1,848 other ranks, the average length of whose stay in Taranto had only been twenty-nine days. Two men died on the voyage from malaria while thirty other cases were transferred direct to hospital on arrival on October 16, and of those one died.

(*c*) On October 17, 1917, H.M.T. "Briton" left for Egypt with eighty-seven officers, 37 nurses and 1,598 other ranks, the average of whose stay in Taranto had only been two days. On arrival on October 20, one case of malaria was transferred to hospital.

(*d*) Also on October 17, 1917, H.M.T. "Kashmir" left with 104 officers and 2,005 other ranks, whose average stay in Taranto had been ten days. On arrival in Egypt on October 20, three men were transferred direct to hospital with malaria.

Considering the short duration of the voyage, these figures, more especially those of (*a*) and (*b*), indicate exceedingly high infection rates. Moreover, while the amount of sickness developing on board would naturally be affected somewhat by the dates of sailing, the very direct and marked relation which exists in each case between the sickness and the length of stay in Taranto is worthy of special note as pointing to that place as the origin of the infection.

Prevalence of Anophelines.

(7) In this same connexion definite information regarding the prevalence of anophelines in the camp during the summer and early autumn of 1917 would have been of the greatest value. All are agreed that mosquitoes were abundant, and even so late as December hibernating anophelines were quite plentiful and could be taken in any of the permanent buildings in and around the camp. Unfortunately, the only definite record of anopheline catches during the autumn is one for a daily search in eleven tents near the centre of the camp, between October 19 and 31, and made by the entomologist Serjt. Hargreaves, soon after his arrival. The total catch was thirty-two, or just under a daily average of three. The number is not large, but, considering the lateness in the season, we may conclude that anophelines had been quite numerous during the earlier months.

Conclusions.

(8) The above facts and figures, which are all that we have to go on in estimating the malaria conditions in the camp at Taranto during 1917, are far from complete. It must be remembered, also, that the incidence of infection must have varied greatly at different times and in different parts of the camp, and, where this is the case and only a limited number of facts are recorded, the tendency is always for these to be the best or the worst and rarely an average. Making every allowance for this probability, however, the evidence still makes it difficult to avoid the conclusion that the evil reputation for malaria which the camp had acquired by the end of 1917 was not wholly without justification, and that it had become a matter of considerable urgency that, if at all possible, similar danger to the troops should not be allowed to recur during 1918.

Campaign during 1918.

(9) In December, 1917, I was sent to Taranto to see what could be done. Fortunately, at that time Colonel Sir Ronald Ross was under orders for Salonika, and he came out with me to Taranto on his way, so that I had the advantage of going over the whole ground and discussing on the spot with him what I considered the chief danger points and the scheme of operations which I hoped to put into force. These plans I have already described fully in my note of May 19 (a copy of which is attached as Appendix A) so that it is not necessary to repeat them here, but only to explain how they had to be modified or extended to meet different difficulties as they arose.

Protection from Mosquitoes.

(10) In my original programme I had given a prominent place to protection of the troops from mosquito bites, and it was for this reason that hutted accommodation was asked for. Unfortunately the type of hut supplied for the greater part of the camp—the "Hospital Nissen"—is one which is structurally difficult to render mosquito-proof and, if fully proofed, would be almost untenantable in a hot moist climate like that of Taranto. Later also, when the stone huts were erected, the gauze provided for the proofing was of too large a mesh to be effective. Various experiments were tried for rendering the mesh smaller by successive coats of paint, but this did not prove satisfactory and it was decided to use a double layer of the gauze should mosquitoes become so numerous as to make this necessary. Fortunately this was never required.

Destruction of Mosquitoes.

(11) The destruction of anopheline mosquitoes usually takes the foremost place amongst the preventive operations in a campaign against malaria, but, for the reasons given above, it became almost our sole protection at Taranto. Fortunately the work was started early, and from January onwards the training of the staff in seeking out and killing hibernating adults, and in searching for and oiling or draining the breeding places of larvæ was proceeded with continuously

by Captain Parker, R.A.M.C., my assistant, and Serjt. Hargreaves, the entomologist. At the same time large-scale maps were prepared on which each place requiring regular attention such as houses, wells, troughs, ditches, pools, etc., were marked down and numbered. At first and throughout, attention was directed chiefly to the actual camp site and its immediate neighbourhood; but, as the work became fully organized in one place it was extended to another in an ever-widening area, so that first the camp, then the inner circle, later the outer circle and finally an area even somewhat beyond, was brought under control. This gradual extension of the work is a point of some moment as it ensures the earliest and greatest concentration on the more important areas and lessens the risk of any danger points being overlooked. Moreover, the gradually increasing staff is more easily trained, and their keenness is stimulated by getting charge of sections as soon as they are fit for the work. Simultaneously, Major Kenworthy, R.E., was doing equally useful anti-malaria work in clearing and regrading the surface drains of the inner and outer circles, and in underdraining the main seepage areas as explained in my note of May 19, 1918 (Appendix A). The chief cause of the trouble at Taranto is that both the surface soil and the underlying rock are extremely absorbent of water. The surface is undulating and much of the rainfall soaks into the ground and later oozes out at a lower level forming extensive marshy patches on the slopes or in the hollows. The root idea of the drainage plan was to run off all rain-water as quickly as possible, and so reduce soakage to a minimum and to further dry the ground by underdraining the broad marshy areas. This plan was quickly grasped and the whole work carried out by Major Kenworthy. A separate report written by him is attached as Appendix B.

To this early work against the hibernating mosquito, well before breeding has started, I attach the utmost importance at all times, but in the present case it was pushed to the utmost, and continued throughout the summer in an endeavour to make good the defects in the mosquito-proofing of the huts. As will be seen later, it has been attended with particularly successful results, and rendered the absence of efficient proofing of little moment.

Breeding Places in Camp.

(12) I had anticipated little trouble from any of the possible breeding grounds within the actual camp site, but later events proved that my hopes had been somewhat too sanguine. Along the full length of the northern edge of the camp, between it and the shore of the Mare Piccolo, is a rather steep bank, in which are several seepage areas. Like the similar areas in the inner and outer circles, these are more or less extensive patches of constantly wet ground, due to water oozing out where a saturated stratum of rock, overlying a layer of clay, outcrops on the slope. Their permanence, even over prolonged periods of drought, is easily understood when one considers that, on experiment, samples of rock (a coarse, loose limestone) were found to be capable of absorbing about thirty per cent of their volume of water. Being always wet, these areas get covered with coarse, rank grass and flags, and, if at all extensive, are very troublesome to deal with by hand-oiling. The only satisfactory method of treating them is by a series of underdrains, leading to a common outfall, where the discharging water may be oiled by an automatic drip. This is a simple, inexpensive and reliable arrange-

ment, and it was used in each of the areas in the circles. It was also used for the largest of the wet areas on this bank, just under the Nurse's hostel and behind O.O. shed. Two smaller areas, one near the Reinforcement Camp North and the other at the Royal Air Force Jetty, were not underdrained, as I had expected them to dry up quickly. They remained wet throughout the year, however, and had to be constantly treated by hand. They should certainly be underdrained if the camp is to be continued through another season.

Along the edge of the wharf the bank was cut back to give more accommodation, and was in part faced with stone, with weep holes at intervals; in part the cutting and digging continued throughout the year. From both these areas water percolated freely, and was collected in two main ditches, running along the length of the wharf, and several subsidiary ones at right angles. The ditches and bank remained wet throughout the year, and, though three automatic drips were kept going constantly, the greater part of the oiling had to be done by hand. On four occasions during the season larvæ were found in this area, but they were quite small, and had obviously only been recently hatched out.

Wells.

(13) At first it had been intended to have all wells either fitted with pumps or closed down altogether. In actual practice this had to be modified somewhat to meet the conditions arising later on in the year and the requirements of the farmers. In some cases wells ran almost dry, so that the pumps would not work efficiently, and for these mosquito-proof lids had to be provided. As the demands for irrigation increased also, later in the summer, the number of pumps required would have been large. Arrangements were made, therefore, to have those wells which were used for irrigation only oiled once a week.

Altogether 170 wells were treated, including 57 which had pumps fitted.

Palude Taddeo.

(14) In the original scheme of operations the Palude Taddeo was omitted, as, owing to its distance from camp and its surroundings, I did not consider it likely to be a serious source of danger. Moreover, it is so large that, if it were to be dealt with at all efficiently, the expense would be heavy. Later on, as stated in my note of May 19 (Appendix A) the Italian authorities started to drain the main part of this marsh, and it was decided that we should continue with that part nearest to us. The work was begun, but never got further than the taking of levels, as the progress made by the Italians was slow, and the dangerous season had passed before their main drain was sufficiently advanced to allow of our going on. Should the camp be continued next season, work on this marsh should be taken up again as the removal of the Italian Anti-aircraft Station from its present site between our camp and the Palude Taddeo will enhance the potentialities for danger of the latter very materially.

Bounds.

(15) The question of what areas should be considered as "out of bounds" for the troops on account of malaria was rather a difficult one. During the winter months, when there was no danger of malaria infection, the limits had been fixed on general grounds, and were made as wide as possible. They are shown by

the outer line in the attached map. As the summer advanced, however, *Anopheline* mosquitoes began to swarm in the areas beyond the outer circle. The danger of infection was considerable, and the limits had to be drawn in as shown by the inner line in the same map. But there was no means of arriving at a definite safety limit, and this latter line could only be regarded as a compromise between the danger of malaria infection on the one hand, and the disadvantages, on general health grounds, of curtailing the men's walks in the evenings in a hot, damp climate like that of Taranto, on the other. Meanwhile the mosquito infection rate and the incidence of malaria amongst the Italian troops at the Anti-aircraft Station (A on the map), were carefully watched, and as soon as these showed signs of increase, about the middle of August, the "out of bounds" line was drawn further back to the line of the camp area. It is probable that some danger was incurred by allowing the men to go so far afield so late in the season, but, in the interests of the general health and comfort of the camp, the risk taken was, I think, a necessary one. As we shall see later, little harm appears to have resulted.

Staff.

(16) For malaria work it is much more important that the staff should be intelligent, well trained, active and thoroughly supervised than that its numbers should be large. That under Captain Parker was composed of skilled personnel from 112th Sanitary Section and picked men from 196th Labour Company for supervision and the more technical duties, with a varying number of British West Indian troops for work on drainage maintenance. The strength varied slightly from month to month, according to the work which had to be done, but, so far as possible, the men once trained were never changed. In January the average daily number employed were seven N.C.O.s and men from the Sanitary Section and two British West Indians. By the month of June the numbers had risen to 12 N.C.O.s and men of the Sanitary Section, 4 privates from 196th Labour Company, and 17 British West Indians, and, later, to 13, 7 and 21 respectively. The numbers are small for the area which had to be covered, and it would have been impossible for the staff to undertake the work but for the great saving in labour that resulted from the underdrainage and from the automatic drips. Supervision also was greatly facilitated by the use of one motor cycle and six ordinary bicycles.

Underdrainage.

(17) So soon as the surface drains were cleared and graded by Major Kenworthy, they were taken over by Captain Parker, and the maintenance was done by his staff, except in the case of difficult repairs, when Major Kenworthy again came to his help. From May to September the growth of vegetation was rapid, and the keeping of the drains clear of weeds, especially those which remained wet, would have required constant and unremitting attention. To avoid this heavy and recurring labour, the underdrainage was not confined to the seepage areas, but was extended also beneath the upper lengths of the surface drains, where the flow of water was inconstant and tended to stagnate and form pools. These latter underdrains proved most successful, as by drying the upper reaches of the surface drains the growth of vegetation was checked and the labour of clearance reduced to a minimum.

Automatic Drips.

(18) The automatic drips also resulted in a great saving of labour. They were used in the lower lengths of the surface drains or wherever there was a constant flow of surface water. They worked well, and the only attention they required was refilling at intervals of from three to four days. At first the tins of oil were left in the open on small stands over the drains on which they were being used; but later they were fixed in small lock-up manholes. This latter arrangement proved much more satisfactory, as it prevented interference and theft.

For use in these drips waste aeroplane oil was collected from the Royal Air Force, as also dirty oil which had leaked on to the wharf from damaged tins. Both oils proved satisfactory, and the saving so effected was considerable. The same waste oils, mixed with an equal quantity of cresol, were used for spraying crabholes, or, with double the quantity of kerosene, for ditches. Kerosene alone was used for the wells.

The total quantity of oils and cresol used during the whole campaign was: Kerosene, 519½ gallons; waste oil, 587 gallons; cresol, 24 gallons. The quantities cannot be said to be excessive.

Meteorological Conditions.

(19) There was nothing out of the common in the weather conditions during 1918. The monthly rainfall from 1908 to 1918 and the mean temperature and the humidity for the years 1916 to 1918 are given in the charts.

Anophelines.

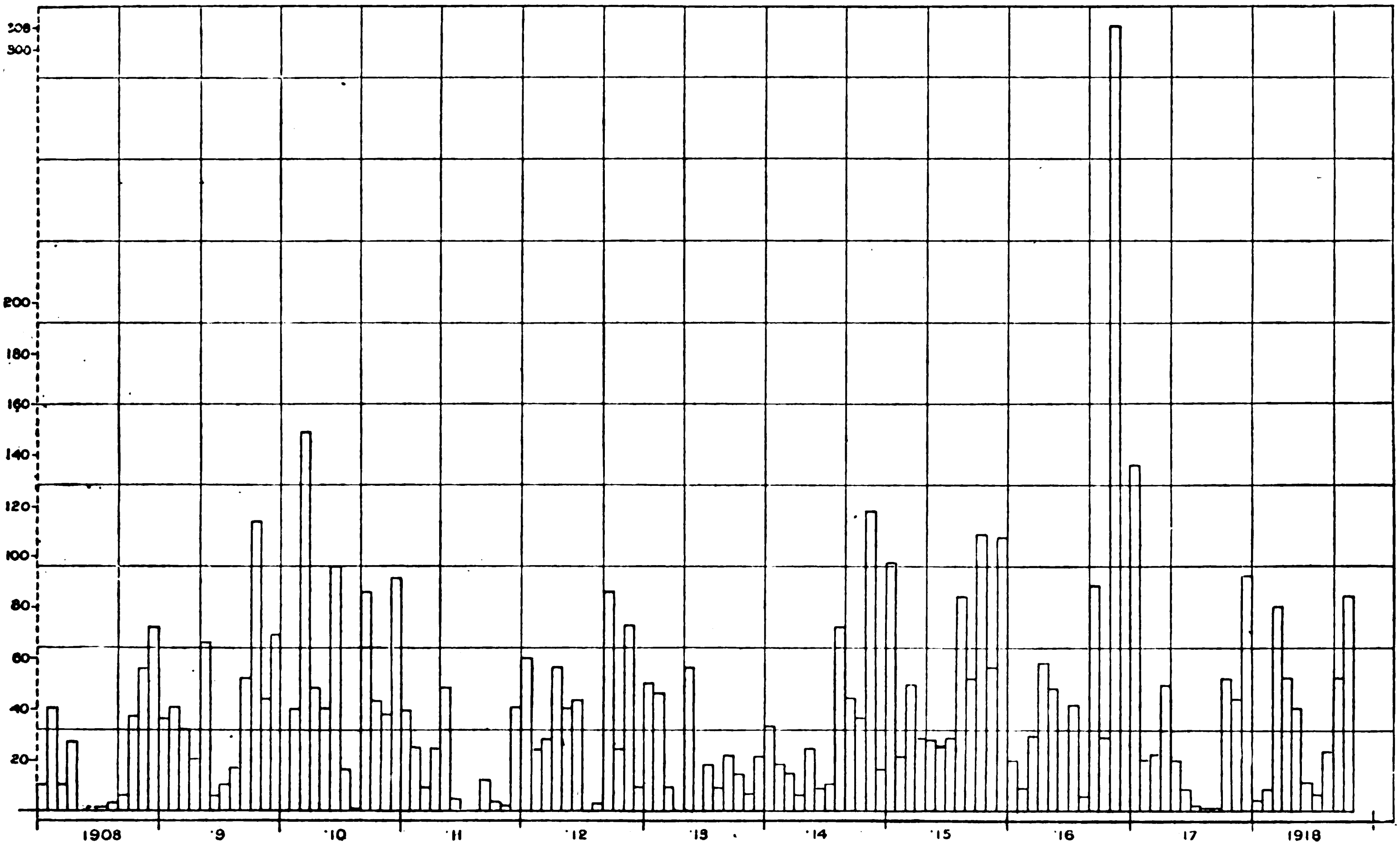
(20) The *Anophelines* found here are *Anopheles maculipennis* and *Anopheles bifurcatus*. The former was chiefly prevalent to the east and south of the camp and later on in the year. The latter to the west and in the spring. This difference in distribution was due to the greater number of wells and troughs on the west of the camp and of ditches and marshes on the east and south. Only one specimen of *Anopheles superpictus* was taken, and it was probably, therefore, an importation.

The dissection of anophelines from different areas was started early in April, and continued regularly throughout the year as opportunity was found; 949 mosquitoes in all were examined, and the results were as follows:—

Source	Stomachs		Per cent	Salivary glands		Per cent
	Examined	Infected		Examined	Infected	
Camp..	122	19	15	119	3	2·0
House 14	97	3	3	73	1	1·25
Salina Grande	163	8	5	150	4	2·6
House 31	53	4	5	44	1	2·0
House 26 and Italian Anti-Aircraft Station	514	40	8	519	3	0·5

Anopheles maculipennis was more often infected than *Anopheles bifurcatus*. The first infection was found on June 24, 1918, and the latest on November 25, 1918.

CHART I.



MONTHLY RAIN RECORD TARANTO. 1908 TO '18. 1. DIVISION = 4 MILLIMETRES

CHART II.

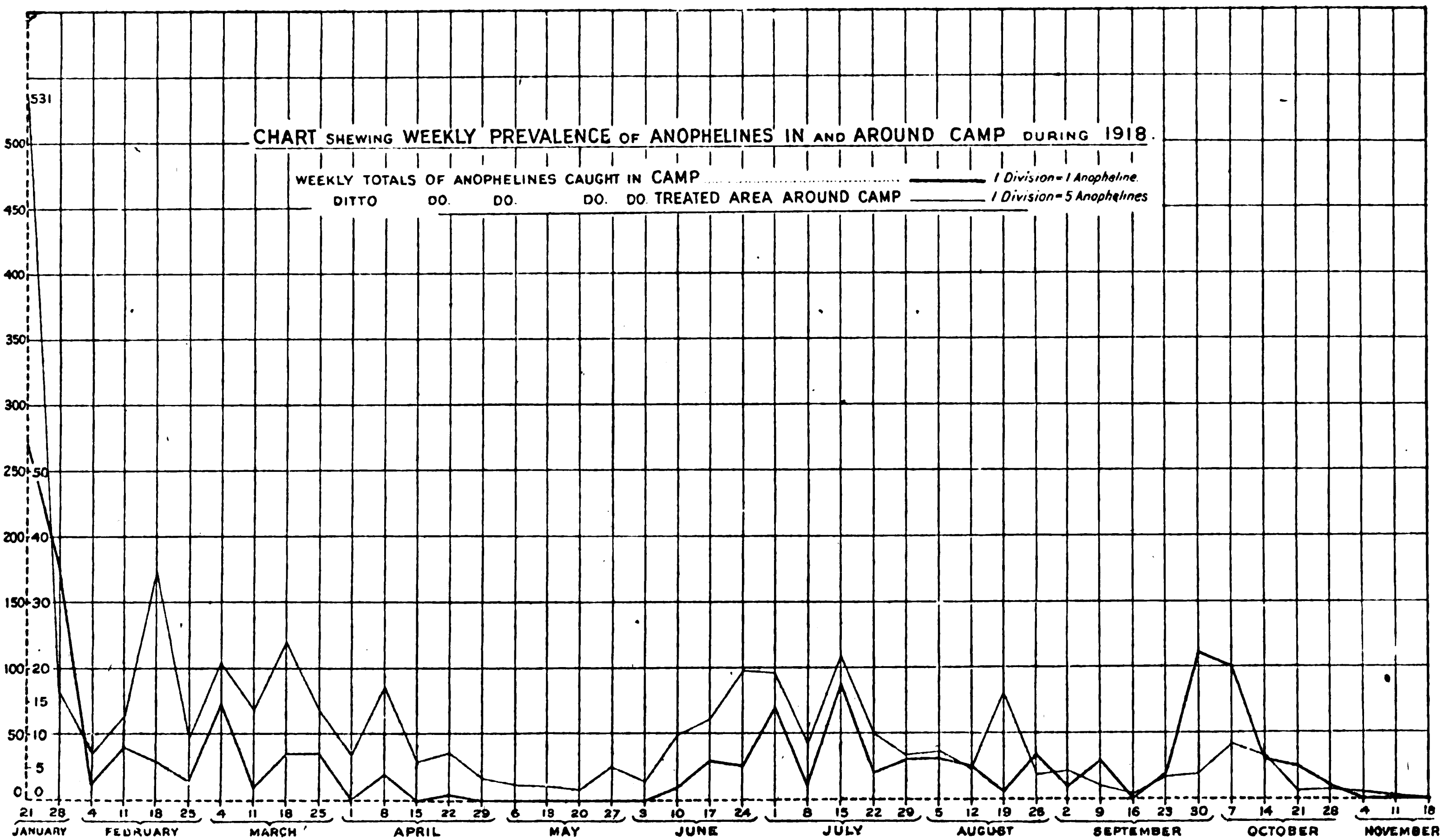


CHART SHEWING WEEKLY PREVALENCE OF ANOPHELINES IN AND AROUND CAMP DURING 1918.
WEEKLY TOTALS OF ANOPHELINES CAUGHT IN CAMP — 1 Division = 1 Anopheline.
DITTO DO. DO. DO. DO. TREATED AREA AROUND CAMP — 1 Division = 5 Anophelines
531
500
450
400
350
300
250 50
200 40
150 30
100 20
15
50 10
5
0 0
21 28 JANUARY
4 11 18 25 FEBRUARY
4 11 18 25 MARCH
1 8 15 22 29 APRIL
6 13 20 27 MAY
3 10 17 24 JUNE
1 8 15 22 29 JULY
5 12 19 26 AUGUST
2 9 16 23 30 SEPTEMBER
7 14 21 28 OCTOBER
4 11 18 NOVEMBER

Chart III.

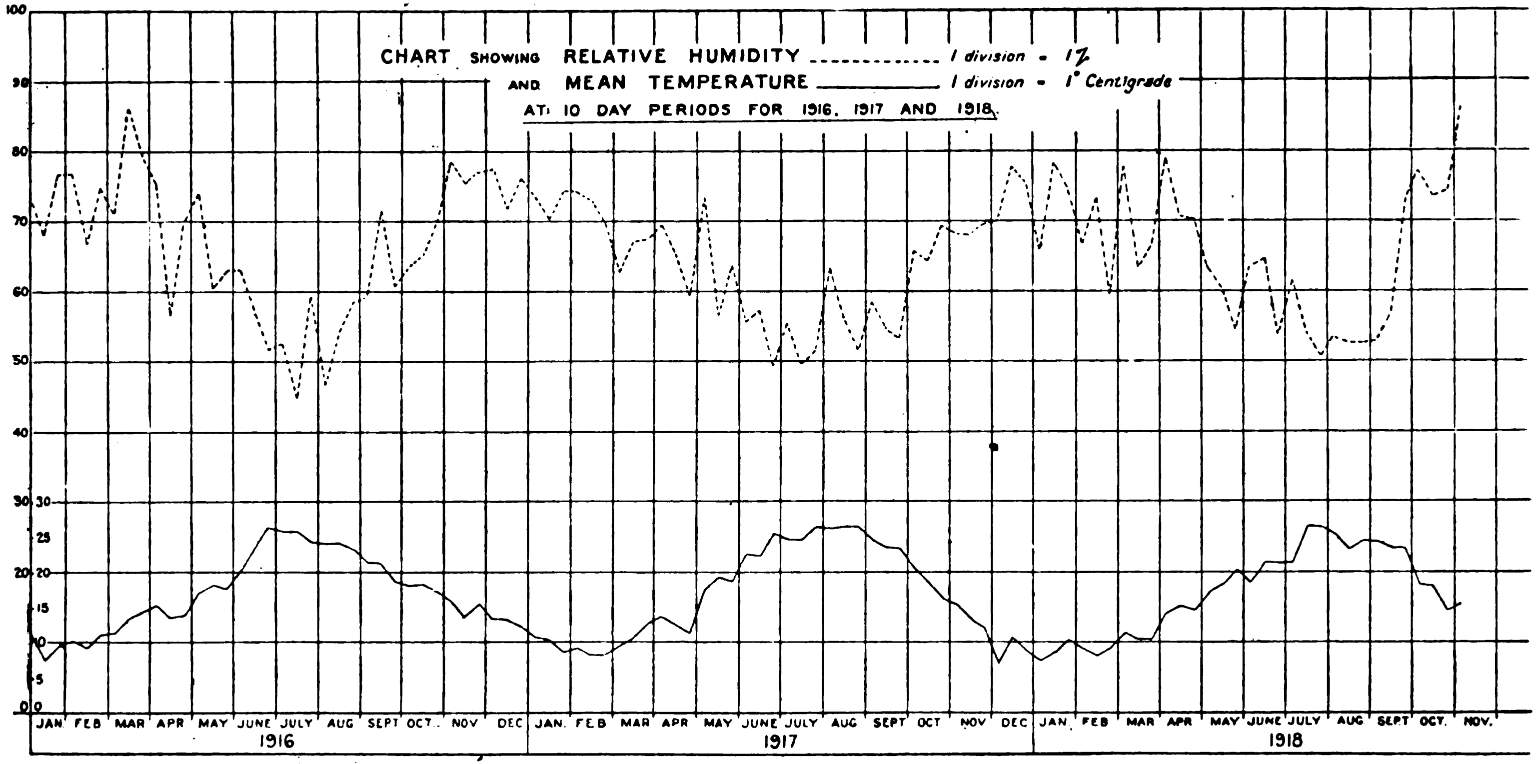


CHART SHOWING RELATIVE HUMIDITY .... 1 division = 1%
AND MEAN TEMPERATURE ———— 1 division = 1° Centigrade
AT 10 DAY PERIODS FOR 1916, 1917 AND 1918.
100
90
80
70
60
50
40
30
20
10
0
30
25
20
15
10
5
0
JAN. FEB MAR APR MAY JUNE JULY AUG SEPT OCT. NOV DEC
1916
JAN. FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC
1917
JAN. FEB MAR APR MAY JUNE JULY AUG SEPT OCT. NOV.
1918

Chart IV.

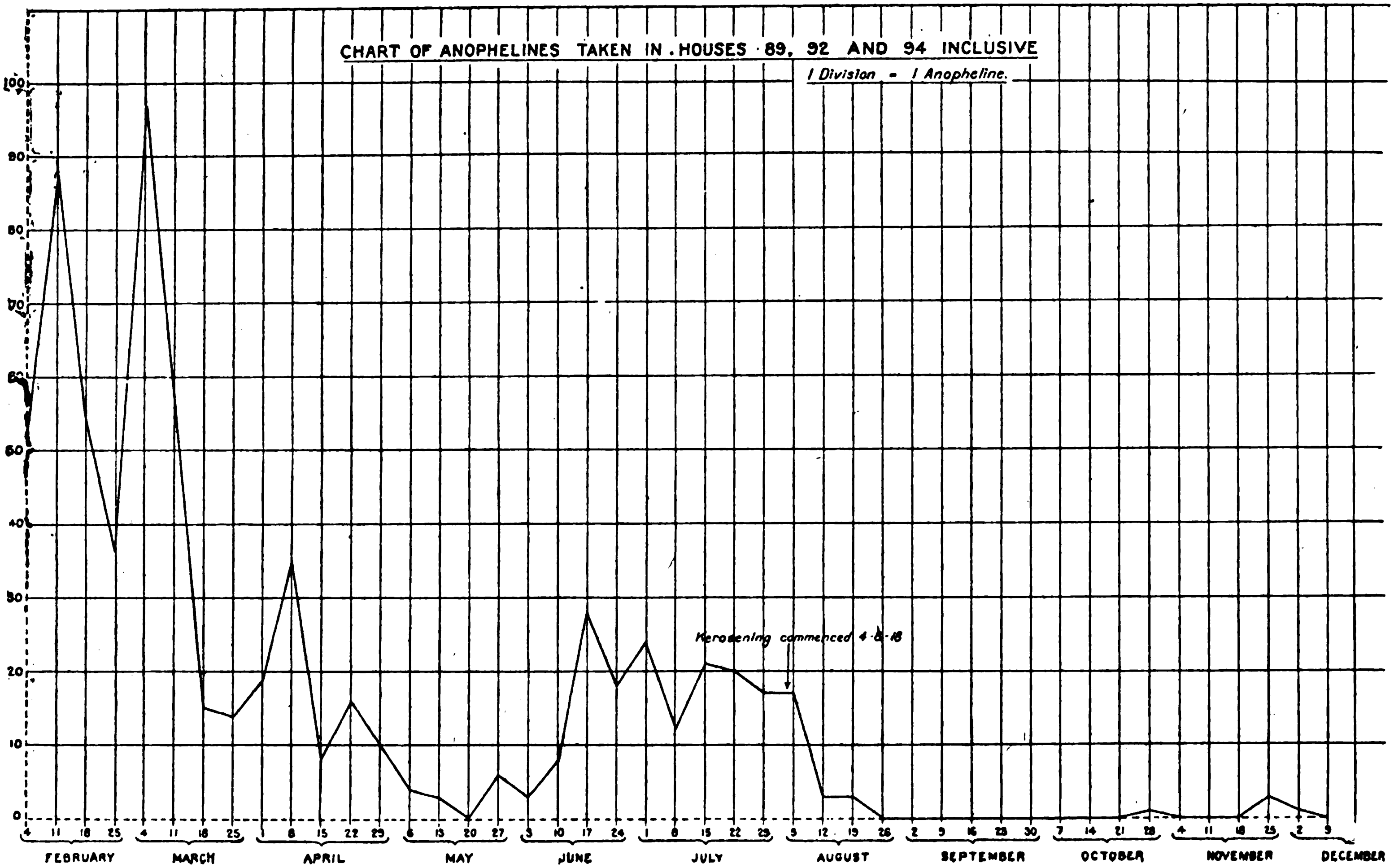


CHART OF ANOPHELINES TAKEN IN . HOUSES 89, 92 AND 94 INCLUSIVE
1 Division = 1 Anopheline.
Kerosening commenced 4·8·18
100
90
80
70
60
50
40
30
20
10
0
4 11 18 25 4 11 18 25 1 8 15 22 29 6 13 20 27 3 10 17 24 1 8 15 22 29 5 12 19 26 2 9 16 23 30 7 14 21 28 4 11 18 25 2 9
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER

One very interesting point in the above table is the very high percentage of stomach infections amongst the mosquitoes caught in camp. This was most probably due to the frequency of human carriers amongst the troops invalided from Salonika, and shows the potentialities that existed for the disease to spread had *Anophelines* been at all numerous.

Of the three *Anophelines* caught in camp with infected salivary glands, and therefore in a condition to convey infection, two were caught in huts which had not been occupied for over a week, and one in a dugout near the Sisters' quarters. None of them had fed recently, so that it is unlikely that they had done any harm.

Distance of Flight of Mosquitoes.

(21) The results of an interesting experiment in this connexion are well shown in chart IV. The curve in this chart represents the total weekly catches of *Anophelines* in three houses. During the months of June and July the weekly catches had remained high, though all the neighbouring known breeding grounds had been abolished. On August 4 oiling of a large breeding ground on the opposite side of the Salina Grande was started to see whether this would have any effect. Immediately the catches fell to zero, and remained so while the oiling of this ditch was continued. The mosquitoes in these three houses had evidently been coming right across the Salina Grande, a distance of approximately 2,000 metres.

RESULTS OF 1918 CAMPAIGN.

Prevalence of Anopheline Mosquitoes.

(22) Early in January, 1918, at the commencement of the work, it was arranged that careful records should be kept of all adult *Anopheline* mosquitoes caught and destroyed in the huts and tents within the camp and also in certain houses scattered over the protected area. Such records are most useful in guiding the work, as not only do they quickly show the existence of any breeding grounds which may have escaped notice, but also frequently indicate their approximate position. Moreover, after the work is over, the records remain to show the progress that was made. It is for the latter purpose they have been used in chart II.

In this chart the thin curve shows the total weekly catches of *Anophelines* from January to November, 1918, in eight houses—numbered 14, 33, 35, 36, 94, 92, 89, and 26—forming a semicircle round the camp, but near the outer limit of the protected area. The thick black curve in the same chart shows on a five times larger scale the total number of *Anopheline* mosquitoes caught week by week in a search of every hut and tent in the camp area, and also in three houses immediately adjoining.

The chief point of note in the charts is that both curves show a marked fall (decreased incidence of *Anophelines*) during the summer, instead of the usual rise. The results must appear almost incredible to anyone who had not actually experienced them, but the fact that the curves correspond so closely, though representing the catches of two squads working quite independently, vouches for the accuracy of the figures. To anyone living in the camp throughout, the facts were quite apparent. This aspect of the chart alone is sufficient to mark the campaign as a successful one.

A further point of interest is the rapid fall of both curves between January and April. This illustrates well the advantages of a vigorous campaign against the mosquito during the early months of the year, when breeding is still in abeyance or slow and intermittent. In this way the number of mosquitoes left to start the summer's brood is reduced to a minimum, and swarming, if it does occur, must be greatly delayed. In the present case, for the whole period April 22 to June 3 not a single *Anopheline* was caught in the course of six weekly searches of every hut and tent in camp.

In June and July, with weather conditions more favourable to the mosquito and an increased flow in the springs following on the rain of March, April and May, there was a slight rise in the catches of *Anophelines*, but even during this period the catches must be considered remarkably small, when one thinks of the number of huts and tents that were searched weekly.

From the middle of July the catches again kept low till the end of September, when a sharp rise took place. From a consideration of the curves this was obviously due to some local breeding ground that had escaped notice, and, as a matter of fact, nearly all the mosquitoes caught were taken in the eastern portion of the camp. Suspicion fell on the Italian Marconi Station, permission to enter which had not previously been granted. This was at once obtained. Two tank breeding-places were found, and after these were emptied the mosquito catches again quickly fell to zero, where they have since remained.

The reduction in mosquitoes in the camp has been remarkable, and far exceeded my expectations. Perhaps the conditions may best be expressed by a statement that, during July, the worst month of 1918, *Anophelines* were five times less in evidence than they are normally in January. It can quite safely be said without exaggeration that the men who have seen even one *Anopheline* mosquito in camp this year must be few.

Primary Attacks amongst the Permanent Staff.

(23) The best of all tests of the success or otherwise of the campaign, however, is the actual number of infections that took place. For this reason the most scrupulous care has been observed in having every primary case of malaria reported and in inquiring into its previous history. The total number of such cases amongst the white troops forming the permanent staff of the camp from April 15 up to date has been 55, of which 18 were malignant tertian, 28 benign tertian, and 9 were diagnosed on clinical grounds. The usual basis of the latter diagnosis was the absence of other definite disease, the type of fever and reaction to quinine.

It has been quite impossible to obtain accurate figures which would give definite information regarding the number of troops resident in the camp during 1918 who had or had not previous exposure to infection, but out of a total of 2,398 present on November 1, 1918, no less than 1,215 had been here during the malaria season of 1917 also.

Of the fifty-five primary cases of malaria referred to above, thirty-four gave definite histories of exposure to infection during 1917 (examples are given in para. 5 above), and, in addition, of one or more attacks of undiagnosed fever with or without admission to hospital during the autumn of 1917 or the first three

months of 1918. The actual treatment in all these cases is not known, but, in the majority, it was by quinine. These cases must obviously be taken as old infections contracted during 1917, and should, therefore, be excluded from this year's figures.

Of the remaining twenty-one cases, four give clear histories of having been severely bitten by mosquitoes while on conducting duty with goods trains, which halted all night at Nassisi station, a few miles out of Taranto, and in a heavily-infected neighbourhood. Of these men three were on the same train, and were admitted to hospital within four days of each other. The fifth case gives a similar history of having been bitten while on a train halted at a station between Foggia and Bari, which is also a heavily-infected area. These five cases should, therefore, also be definitely excluded from the number of local camp infections.

Sixteen primary infections remain, and must be accepted as local cases, but, even after full inquiry considerable doubt as to whether they are real camp infections during 1918 must remain in all of them except one. With regard to the year of infection, seven were in Taranto during the malaria season of 1917, and may well have contracted their infections then, though the actual attack of fever did not develop till this year. Such cases are quite common, and no less than 17 (11 from Salonika, 2 from Palestine, and 1 each from Egypt, India, Mesopotamia, Mudros and the north of Italy) were admitted to the 79th General Hospital this year. In each of these cases there was a definite history of the patient having been in a malarious district for varying periods up to two years without any manifestation of the disease till on the journey to Taranto. But, even if these cases are all taken as this year's infections, the locality of that infection still remains doubtful. Eleven give quite definite statements of frequent walks in the evenings beyond the protected area into the dangerous zone outside, while four others were on duty on the motor launches, and frequently out late in the evenings all over the harbour. Considering the scarcity of mosquitoes in the camp already referred to, and their abundance outside, the probabilities are all in favour of most, if not all, of these fifteen infections having been contracted outside the protected zone. In only one case do the facts accord with a camp infection during 1918.

Primary attacks amongst Transit Troops.

(24) Statistics or information regarding possible infections amongst transit troops are not easy to obtain. Three such cases have, however, been reported.

One case was undoubtedly a primary infection. The patient had spent three days in camp, and may have got his infection there. At the same time he had been in the train in an infected area for the following two nights, and might equally have contracted the infection then. Considering the almost total absence of *Anophelines* in the camp, and the freedom from infection of the staff residing there permanently, the latter source is the more probable one.

The other two cases were naval details, one of whom had been in camp two and a half months and the other thirteen days. Both gave histories of having been out for walks in the dangerous area outside the camp, and one had served several years in different stations in the East.

Primary Attacks amongst British West Indians.

(25) I have no experience of the liability of British West Indians to malaria infection. They have, therefore, been excluded from the above statistics. That they are not immune, however, is shown by the fact that there were amongst them several relapses of old malaria infections contracted elsewhere. On the other hand, there were, on an average, 3,242 present in camp throughout the malaria season, but not a single primary infection was recorded, although the medical officers had been instructed to watch for the disease.

Statistics of Italian Anti-aircraft Station.

(26) As a contrast to the above figures, the statistics of an Italian Anti-aircraft Battery, situated close to our camp, are of interest. In this battery there were fifty-three men, who arrived between December 26, 1917, and August 7, 1918, from non-malarious areas, and who had never had the disease. Out of these twenty-four became infected during 1918, and fourteen were permanently invalided. This gives the very high infection rate of 45·3 per cent and a wastage rate of 26·4 per cent. These figures show the possibilities which existed.

Conclusion.

(27) In concluding this report, I wish to express my indebtedness to Captain W. Parker, R.A.M.C., my assistant, Major Kenworthy, R.E., and Serj. Hargreaves, R.A.M.C., the entomologist. Captain Parker was my right hand throughout; Major Kenworthy was responsible for the excellent drainage works constructed, and Serjt. Hargreaves showed the greatest keenness and interest in the work. To them is due the success that has been achieved. I could not have been better served, and my duties consisted solely in guidance and control. To Captain O. R. Belcher, R.A.M.C., my thanks are also due for practically the whole of the statistical work, and for the keenness and interest he showed, in following out the histories of the different cases.

APPENDIX A.

A short Note regarding the Anti-malaria Precautions which are being taken at Taranto Rest Camp.

(1) The parasites which cause malaria have a double life cycle in the blood of man and in the body of the mosquito. In the former, reproduction is asexual and takes place by simple division of the two or three days old adults into a number of young, which again mature and divide into fresh broods in two or three days' time, and so give rise to recurrent paroxysms of tertian or quartan fever according to the particular species of parasite concerned. Male and female forms of the parasites are produced in the blood of an infected man, but they do not conjugate or give rise to young until they are ingested during the act of feeding by certain species of *Anopheline* mosquitoes. In the body of the mosquito, on the other hand, the cycle is a sexual one, and reproduction occurs only by the conjugation of two individuals, male and female, with subsequent division into a swarm of young, which, lodging in the salivary glands of the mosquito, undergo no further developments until injected into man when the mosquito bites. This latter cycle in the *Anopheline* mosquito, being sexual, may be considered as regenerative. Each of these cycles is restricted to the special host, and no in-

fection takes place in nature from man to man except through the intervention of certain species of *Anopheline* mosquitoes or from mosquito to mosquito, except through the intermediation of infected man.

(2) The above facts regarding the life history of the malaria parasites have been definitely established, and on them are based the measures which are generally taken for the prevention of malaria infection. It is obvious that—

(i) If man could be protected from mosquito bites; or (ii) if all *Anopheline* mosquitoes could be destroyed; or (iii) if *Anophelines* could be prevented from becoming infected, malaria would soon disappear. Action directed towards any one of these objects, or towards preventing the development of the malaria parasite in anyone bitten by an infected mosquito, would be quite sufficient if only it could be made absolute. Unfortunately, this can rarely be done, and, in a place like Taranto, is, for many reasons, quite impossible. At that place, a combination of measures has therefore had to be relied on, those being selected which under the special conditions obtaining and with the materials available, appeared most likely to give the best results and, at the same time, to be cheapest and to offer a minimum of interference with military requirements. A knowledge of what these measures are, and how far they are likely to be successful, may best be attained by considering them in four groups according to the object at which they aimed.

(3) *Protection from Mosquito Bites.*—For the individual with a clear conception of the risk that mosquito bites entail within a malarious zone, personal protection from these bites is by far the most valuable prophylactic measure which he could adopt. It is simple, and if carefully carried out gives absolute security. With large and varying numbers of troops, however, the giving of facilities for complete individual protection would mean a prohibitive expenditure. Moreover, there would always be large numbers of men, especially amongst troops in transit, who would be ignorant of the risks, and would quite naturally look on the discomfort of the mosquito net, the avoidance of walks in the evening without veils and gauntlets, the inconvenience of double closed doors to sleeping rooms, etc., as fussy and unnecessary restrictions to be avoided on every occasion on which they could do so undetected. For these reasons, and also because the Nissen huts, which form a large part of the accommodation at Taranto, are unsuited to a scheme of complete protection from mosquitoes, and because of the difficulty of obtaining the necessary proofing materials, it has been necessary to relegate this method of malaria prophylaxis to a second place, and it is on mosquito destruction that main reliance will have to be placed. At the same time, very important protective measures under this head have been undertaken; all sleeping accommodation and the canteens, Y.M.C.A., and other huts, where the men are likely to gather for the evenings, are being proofed against mosquitoes as far as possible with gauze and double doors; all sleeping accommodation is regularly searched for any mosquitoes which may have gained entrance or have been trapped between the double doors; the same barrack rooms will be fumigated at intervals; guards and other men on night duty are being provided with veils and gauntlets; areas where mosquitoes have become prevalent will be placed out of bounds after sunset; and all troops will be warned of the danger of mosquito bites and be encouraged to take precautions against them by placards, notices and lectures. Specially proofed bell tents are also being got ready in case they have to be used.

(4) *Destruction of Anophelines.*—(*a*) It very soon became evident that this would have to be the main defence against malaria at Taranto, and special care has been taken therefore to make it as complete and thorough as possible. A detailed survey of all the likely breeding places, both inside the camp and outside to a distance of one and a half miles from its border, was started early, so as to obtain information on which might be based as accurate an estimate as possible of the danger to be anticipated from the different areas, and of the relative importance and urgency of the works which might be necessary in each. This survey confirmed the general conclusions which I had previously arrived at, and which had been endorsed by Colonel Sir Ronald Ross at his visit, but it had also been of value in bringing to light some new breeding grounds of importance which previously had escaped notice.

(*b*) Each year a certain number of mosquitoes and their larvæ hibernate over the cold weather, and it is from these that the first of the new season's brood is developed in the spring. In my previous experience I have found a rigid winter campaign against these hibernating mosquitoes of the utmost value in lessening the risk of swarming and the work which had to be done later on. Such a campaign was therefore started early and carried out simultaneously with the survey already referred to. All possible resting places for mosquitoes in houses, huts, sheds, etc., both within and outside the camp area, were carefully and repeatedly searched for *Anophelines*, and these destroyed. At first it had been my intention to do this by fumigation. This would have been easier, but a suggestion to try it met with so much opposition on the part of the farmers that all further thought of it was abandoned, and the slower and more laborious method of searching was used instead. This change has not been without its advantages, however, as it enabled me to obtain periodical censuses of the mosquitoes in particular areas, and these have been of great value in checking the results of the survey referred to above, and also in measuring the effects of the different anti-larva, operations, draining, oiling, etc., which have been undertaken, and in estimating their relative value.

(*c*) Both the survey and the winter campaign have been of great help in enabling me to train a number of men in the work of recognizing *Anopheline* mosquitoes in the egg, larval and fully developed stages, and of hunting out their breeding grounds, and in searching for the places where they lie up during the day. These men will be specially useful later on, and it is hoped that they will not be moved.

(*d*) The whole of the breeding grounds which are likely to affect the health of the troops adversely have been conveniently grouped for descriptive purposes into three areas: (1) The actual camp site; (2) the inner circle; (3) the outer circle; and this grouping may be adhered to as it emphasizes rather well the important point of distance from the camp. The actual camp site occupies a semi-circular area of roughly 800 metres radius on the southern shore of the Mare Piccolo. The "inner circle" lies immediately outside of this, and is a concentric semicircular band about 1,000 metres in width, and the "outer circle" is a second concentric band outside that again.

(*e*) As a result of the survey referred to, it was found that within the camp area the number of *Anopheline* breeding places was not large, nor their extent great. They consisted chiefly of wells, tanks and cisterns. All of these have been fully

dealt with—the wells by sealing them down completely; the tanks and cisterns by draining—and no further danger may be anticipated from them. At the same time, all low lying patches of ground where water might collect have been drained, tins and other pots which might act as receptacles of water have been collected and are being used for making paths, and all hollows in tree trunks which might hold water and act as potential mosquito places, have been plastered up with mud. Within the camp area, I think, it may safely be said that no single breeding ground for mosquitoes now remains.

(*f*) In the "inner circle" the breeding grounds, both actual and potential, were much more numerous and, adjoining the camp, as this area does on all sides, except to the north, it was by far the most dangerous from the point of view of malaria. It contains a large number of farms, each of which has numerous wells and troughs for the supply of drinking water, for watering of stock and for irrigation. Most of these were acting as reservoirs of hibernating mosquito larvæ, and would certainly have formed excellent breeding grounds during the mosquito season. They presented a very considerable difficulty, as obviously they could not be closed or oiled. Fortunately the Italian authorities came to our assistance, and, by the issue of an Ordinance (copy attached B) that each owner would be held responsible for keeping every well or collection of water on his ground mosquito-free, placed us in the excellent position of being able to come to the help of the farmers in complying with the requirements of the Ordinance, instead of being outsiders interfering unnecessarily with their water arrangements. An agreement was quickly arrived at allowing us to close down most of the wells, and to drain some of the tanks and oil the others, on condition that we provided one or two cheap lift pumps for the remaining wells on each farm. The difficulty has been completely overcome, and without friction of any kind. At the same time, all trees in the inner circle close to the camp site have been treated similarly to those within the actual camp area, and all small collections of water have been kept free from larvæ by oiling or draining, pending the completion of the larger drainage works which have had to be undertaken.

These larger drainage works were necessary owing to the presence of numerous surface drains, much overgrown with long grass and reeds, and liable to contain water for considerable periods after rainfall, and in some cases, permanently. In the eastern half of the circle, the area marked "2" in the map, there was also a large tract of low lying swampy ground. This area "2" was much the most dangerous part of the inner circle and, indeed, was the chief source of *Anopheline* mosquitoes in the camp, owing to the great extent of the drains and ditches which it contained, their proximity to the camp site, their dense overgrowth with grass and reeds, and also the fact that many of the ditches and also the low lying swampy ground were constantly supplied with water which percolated out of the hill sides at three points marked D, E, and F, and known locally as No. 17, the Wet Triangle, and R.E. Hill respectively. It was decided that all the drains and ditches in the inner circle should be cleared up and regraded to allow of storm water flowing off more rapidly, and that the three seepage areas, D, E, and F, should be under-drained to three outfalls into the newly cleaned channels at which automatic oil drippers could be placed in manholes. All this work has been excellently carried out, and the control of mosquito breeding within the inner circle should present no great difficulty beyond the systematic upkeep of the drains in good condition, and attention to the automatic drippers.

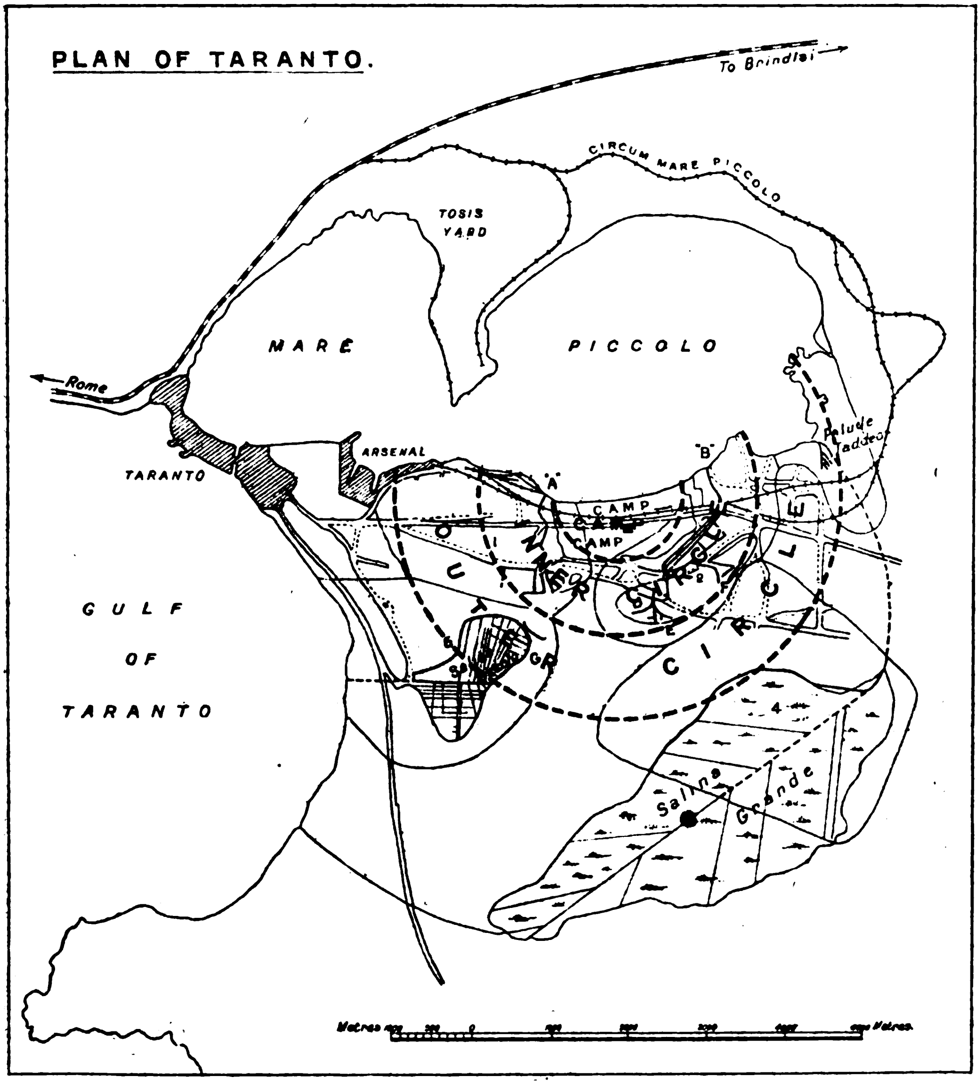
(*g*) The question of how to deal with the outer circle was a more difficult problem. It contains three very extensive marshy areas, marked 5, 4, and 3 in the attached map, and named respectively the Salina Piccola, the Salina Grande and the Palude Taddeo. The two former have been partially drained and reclaimed by the Italian authorities; but the drains had been allowed to get out of repair and to become overgrown and clogged, and all three areas were typical and extensive breeding grounds for *Anophelines*. All are somewhat remote from the camp area, and it was obviously out of the question to deal with them completely as in the case of the inner circle, as the cost of doing so would have been altogether out of proportion to any gain that was likely to accrue. In my experience little danger is to be anticipated for breeding places over one mile distant if the mosquitoes have opportunities of feeding close at hand, and if the intervening ground, as at Taranto, is raised, wind swept and clear of all scrub and trees. The Salina Piccola comes well within the distance, however, and it appeared necessary that the northern part of it, at any rate, should be dealt with. The rising ground G, immediately to the east of this Salina, also remains constantly wet from numerous seepage springs, and this too it was considered desirable to treat. All the drains in this area have been cleared and regraded, so that very little water now lies for more than a day or two after heavy rain. The wet patch of ground also has been underdrained, and the outflow will be kept oiled by automatic drippers in manholes at the different outfalls.

(*h*) The nearest point of the Salina Grande is just over one mile from the camp, but slightly nearer there were a number of drains which it was desirable should be cleared and regraded. As all these drains have their outfall into the nearest portion of the peripheral drain of the Salina, it was thought advisable to clear and regrade the latter also, as shown in the map.

(*i*) It was about Area 3, the Palude Taddeo, that I felt in most doubt. The nearest portion of this marsh is brackish, and *Anophelines* do not breed in it, while the further portion is a continuous breeding ground, and gradually extends in breadth as one goes further from the camp. Little advantage appeared likely to follow partial treatment, and to do the whole of it would have been a very large work. I postponed decision as long as possible in the hope that I should be able to get some definite evidence of the danger which might be expected if it were left alone, but, though it was trapped continually, and all the houses between it and the Camp, and on the edge of the latter, were carefully searched each week, no evidence of any serious danger was forthcoming. On the contrary everything pointed to the probability of our being able to neglect it altogether without risk. At the same time the favourite walk of the men in Camp in the evenings was along the shore of the Mare Piccola in this direction, and it was felt that it would be a serious hardship to them to put the whole of this part of the shore out of bounds. Fortunately the Italian authorities started to drain the main part of the marsh last month, and it was decided by the I.G.C. on a visit shortly afterwards, that it would be well to drain the remaining portion, which is on the side nearest to our Camp, at the same time. This work is now in progress.

(*j*) It is, of course, too early yet to be able to say how far the anti-mosquito measures which I have described will suffice to meet the requirements of the situation, or whether they will have to be extended. But, so far, the

position appears satisfactory, for, while mosquitoes are fast on the increase outside our area, they are becoming fewer within the inner circle and, inside the Camp itself, it is only rarely that an *Anopheline* can be found. Very careful watch, however, is being kept on all the known breeding places, new ones are being



searched for, and all the houses and huts, both within the camp and in the inner circle, are regularly examined for adult mosquitoes so that any increase may be detected at once.

(5) *Protection of Anopheline Mosquitoes from Infection.*—This is really a corollary of the protection of man from mosquito bites, and the measures under

the two heads are very largely identical, at any rate, so far as the healthy troops in Camp are concerned. Besides the healthy troops, however, there are three classes which require special notice: (*a*) Men actually suffering from malaria; (*b*) men who are probable "carriers"; and (*c*) the resident population.

(*a*) With reference to the first of these classes, all men suffering from fever, even if slight only, will be required to report for treatment, and will be admitted to hospital in which the wards will be absolutely proofed, or they will be transferred out of the danger zone to Faenza. During convalescence these men will be housed in separate barracks and carefully supervised until quite free from danger to others.

(*b*) "Carriers" are likely to be numerous amongst the men being evacuated under the "Y" scheme, and, as they will not be known, the whole of the "Y" scheme men will be accommodated in specially proofed barracks during such time as they may remain in camp.

(*c*) With regard to the resident population supervision will be less easy, but relations have already been established whereby not only do they permit us free ingress to the houses to search for mosquitoes, but they also help us in the work. Later on, when mosquitoes become more numerous and troublesome, it is hoped that they may allow us to proceed further and to fumigate their rooms at intervals when most of the affected *Anophelines* would be destroyed along with the others.

(6) *Prevention of Malaria developing in those who have been bitten by Infected Mosquitoes.*—This is the fourth method of prophylaxis, and for various reasons it is probably the least important. Latterly the taking of prophylactic quinine has rather fallen into disrepute, but this is probably largely due to the fact that too much has been expected of it. For the cure of malaria in man, that is, the suppression of parasites, the result of asexual reproduction, twenty grains of quinine at least are given daily, and often more. It can hardly be expected, therefore, that five or ten grains daily will in all cases be sufficient to prevent the development of that stage of the parasite injected into the blood by a mosquito, and which is the result of sexual reproductions and, presumably, therefore, much more resistant. There is a considerable mass of evidence to show that the smaller doses of quinine do help in preventing the development of a considerable number of new infections, and also in reducing the number of relapses in old cases. They are, therefore, being regularly issued to all ranks in Taranto under supervision.

(7) In carrying out the anti-malarial work in Taranto, I am greatly indebted to Major Kenworthy, R.E., who had done excellent work in connexion with the drainage; to Major Mattei, A.A.M.C., to whose tact and resource the complete absence of friction with the Italian residents is very largely due; and to my assistant, Captain Parker, R.A.M.C., who has shown indefatigable zeal and energy in connexion with the field work.

Headquarters, I.G.C.
May 19, 1918.

J. C. ROBERTSON,
Lieutenant-Colonel, I.M.S.

APPENDIX B.

Office of the Commander-in-Chief of the Department and of the Naval Command of Taranto.

We, Vice-Admiral Commandantore Emilio Solari, Commander-in-Chief of the Department and of the Naval Command, Taranto.

In view of the Royal Decree, May 25, 1915, conferring on us full Military and Civil Powers.

In view of para. No. 636 of the Sanitary Law, August 1, 1907, and General Sanitary Regulations approved by Royal Decree, February 3, 1901.

In view of the Municipal Ordinances of August 15, 1904, and September 7, 1917.

Having considered the necessity of enforcing more strictly the measures for the anti-malaria prophylaxis in the territory within the jurisdiction of this Naval Command.

Order.

Art. 1.—That within the publication of the present orders, it is compulsory for proprietors and tenants in the malarial regions comprised in the territory of this Naval Command, and in grounds suitably situated regarding altitudes, to adopt means for the natural flow of waters in such a way as to avoid the formation of ponds, wells, or sheets of stagnant water, either in large or small quantities, temporary or permanent, artificially created or existing naturally, within greater or lesser distances from dwellings.

Art. 2.—That as a sequence of the above article, it is prohibited to allow any water which is drawn from wells, and which is required for irrigation, to remain in the tanks next to the "Norie," for more than twenty-four hours.

Art. 3.—That drains, pipes and conduits, used from the "Norie" for irrigation of ground, must have sufficient fall and be kept clear so as to allow an easy flow of water and dispersion in ground without causing any stagnation.

Art. 4.—That mouths of wells or "Norie" and all openings in connexion with them must be closed in such a way as to avoid the possible presence of larvæ of *Anopheline* mosquitoes.

The improvements of water wells must be made so as to reduce the size of the mouth of the superstructures and supply a perfectly fitting wooden lid and frame; or, when this is not possible, the mouths of the wells must be completely closed, and suitable pumps fixed. Unused wells must be abolished or closed up with stone slabs.

Art. 5.—That it is compulsory for everybody charged with the construction of roads and canals to prevent waters from becoming stagnant in abandoned sump pits, also, to prevent water from stagnating in any hollow grounds and badly constructed or badly kept gutters.

Art. 6.—That the sanitary authorities will enforce the instructions in the present ordinances, making use of the police agents for the control and actions.

Anybody not complying with the above orders will be tried by a Military Court and punished accordingly, as laid down in Article 129 of the above-mentioned Sanitary Law, and the necessary works will be carried out at the expense of the interested parties by the Direzione del Genio Marina.

Taranto, *Vice-Admiral* (Signed) E. Solari.
February 24, 1918. *Commander-in-Chief.*

Reviews.

THE GREAT WAR AND THE ROYAL ARMY MEDICAL CORPS. By Brevet Lieut.-Colonel F. S. Brereton, R.A.M.C. Vol. I. "Mons, the Marne, the Aisne." London: Constable and Co., Ltd. 1919.

Every officer and man of the Royal Army Medical Corps should read this volume with pride and pleasure. It is written with zest and enjoyment by one who, himself a retired officer of the Corps, can fully appreciate the difficulties and dangers that had to be encountered, and whose experience as a writer of books gives him a happy facility in expressing the salient facts of a tangled and complicated story. The author has succeeded admirably in what must have been a very difficult task. It was necessary to sketch in, with a few bold strokes, the general military situation which formed the background for the activities of the Royal Army Medical Corps, and the brief battle pictures, illustrated by a few simple but effective maps, are excellent. The hardships and sufferings, the privation and dangers, the heroism and the devotion of our officers and men appeal strongly to the author, and he devotes the greater part of his space to the movements of the field ambulances during the retreat and the advance to the Aisne. This adds greatly to the attraction of the book for those who want a good story; but it detracts from its value as a serious account of the doings of the Royal Army Medical Corps in the Great War.

During the three months comprised in the volume under review, the theoretical conceptions of a medical service in war, as laid down in Field Service Regulations (Part II), were subjected to the ordeal of a vast new military crisis. In those three months our Service proved itself capable of many things, but the one great quality that stood it in good stead was its adaptability. Old ideas had to be discarded, new ideas were evolved, regulations were ignored or amended according to the imperative necessities of the moment.

"Clearing Hospitals are Lines of Communication Units." So it was written in Field Service Regulations, Part II. As a matter of fact, the Clearing Hospitals became General Headquarters Units from the day when No. 1 Clearing Hospital started work at Coulommiers during the Marne battle, and continued to be General Headquarters Units until five months later, when Army Corps were grouped into Armies and the Casualty Clearing Stations were passed forward into Army Areas under the command of the Ds.M.S.

"The necessary transport for conveying the sick and wounded to the Stationary Hospitals or to the railway will be provided under arrangements by the I.G.C."

The first few hours of the war proved that the I.G.C. was quite out of reach and out of touch and therefore powerless to help in the evacuation of Field Ambulances and Clearing Hospitals.

All these theoretical conceptions were founded on a diagrammatic representation of war, in which everything and everybody was connected by blue or red or dotted lines, and in which rapid changes of bases, hurried retreats, broken bridges, interruptions of railways, telegraphs and telephones were conspicuously absent.

One of the curious omissions in Brereton's book is that Colonel T. J. O'Donnell is hardly mentioned except in Appendix I, where his name appears as D.D.M.S. First Army Corps. The headquarters of the First Army Corps, considering that the only medical personnel necessary for Corps Headquarters was the Royal Army Medical Corps officer in charge of troops, declined to be provided with an administrative medical officer and, in a fortunate moment for the Force, Colonel O'Donnell was ordered by the D.M.S. to report for duty at General Headquarters, First Echelon. Here, at the nodal point where all information arrived and from which all operations were co-ordinated, Colonel

O'Donnell worked in the closest touch with the Adjutant-General and the Commander-in-Chief and was thus in a position to initiate action of the most vital importance for the front area at a moment when the vast medical problems involved by the change of bases and the arrival of large convoys of wounded from the front, necessarily occupied the full time of the D.M.S. of the Force.

It was at General Headquarters on September 28, 1914, that the conception of the Motor Ambulance Convoys took definite shape. It was from General Headquarters that the Clearing Hospitals, as they were then called, were distributed and moved and that the ambulance trains, arriving from the bases, were directed to those points where the wounded were awaiting evacuation.

Colonel Brereton very rightly fulminates against the use of the empty motor lorries of supply and ammunition columns for the transport of wounded. He misses, however, one of the most important arguments against them. These vehicles must, of necessity, return to supply rail heads. During the retreat and advance, these were changed daily or oftener. It was, therefore, utterly impossible to provide adequate accommodation for wounded at these rail heads, or even personnel to unload them. Colonel O'Donnell organized "rail head parties" consisting of medical officers and men with light equipment, who moved with the rail head personnel and did all they could to succour the wounded; but the situation was quite impossible. The time taken to unload the wounded was a source of terrible inconvenience to the supply department. It was this delay in transport of rations and ammunition, rather than the sufferings of the wounded, that gave the "coup de grâce" to Field Service Regulations, Part II, chap. xi, sec. 91, para. 7. The Q.M.G., Sir William Robertson, intervened during the battle of the Aisne, declaring that the empty lorries must no longer be used for the transport of sick and wounded. This was Colonel O'Donnell's opportunity. His reply was a demand for the immediate formation of Motor Ambulance Convoys. This led to the despatch of Major P. Evans to Paris with authority to gather together fifty Motor Ambulances to form the first of these Units. As times were far too strenuous to permit of keeping up a war diary in the office of the D.D.M.S., General Headquarters, during the battle of the Aisne, this little bit of history was naturally inaccessible to Colonel Brereton, and no apology is needed for introducing it into a review of his book. There are a few inaccuracies that require correction. It is stated on page 267, that "half a dozen" Motor Ambulance Cars were distributed to each Division by September 20, 1914. A few cars were distributed to each Army Corps at that time, but it was not until several months later that more than a few "gift" vehicles, presented to Units, were available for Divisions.

Nurses were not posted to Casualty Clearing Stations until October 31, 1914. The note on this point on page 273 is incorrect.

But, after all, this volume does not set out to be a treatise on Army Medical Organization. It aims at being a story, not a thesis. Colonel Brereton deserves the gratitude of the whole Army for having so ably and so faithfully recorded, for this and for future generations, the tale of what was done and suffered by the Corps whose motto is "In Arduis Fidelis."

S. L. C.

CHEMISTRY FOR PUBLIC HEALTH STUDENTS. By E. Gabriel Jones, M.Sc., F.I.C. London, 1920: Published by Methuen and Co., Ltd. Pp. ix + 244.

On reading this book, one is impressed by the fact that the author has realized the difficulties met with by both instructors and students of public health work. Although many books have been written on this subject, very few of them give the precise details required for carrying out analyses in the laboratory, but Mr. Jones has foreseen these difficulties. A student, working carefully through the book, should have a sound knowledge of the methods used by the best analysts of the present time.

The book is well written, concisely and clearly, it is singularly free from mistakes, and has a very useful bibliography at the end. A list of questions selected from papers set at various examinations should prove of great value to students, as also will a table of the order of analysis of water, to those taking the examination for the Diploma of Public Health.

Diagrams of various pieces of apparatus in use always prove of value, but render the book more expensive; they are not necessary, however, in cases where a good demonstrator is present.

A few suggestions for the next edition might be useful to the author, e.g., the Gerber method for the estimation of fat in milk is in extensive use at present and should be added.

The use of litmus in the Kjeldahl process has been supplanted in the practice of modern, especially biological, chemists by the use of alizarine red which gives a better end point in the titration.

A recommendation by many analysts that the refractive index of fats should be taken at a standard temperature of 40° C. has not been adopted.

The valuable report issued by the Medical Research Committee on the vitamine question, published at the end of last year, has been omitted; however, a reference to a very sound paper is given instead.

Fuller details of the examination of tea, coffee and cocoa, although not of first importance to examination students, would make the book more useful.

Finally the Griess-Illosvay method for the determination of nitrites in water, undoubtedly a very good method, is omitted.

Taking everything into consideration, the book is of great value, and is thoroughly recommended to students of public health.

FEVERS IN THE TROPICS. By Lieutenant-Colonel Sir Leonard Rogers, Kt., C.I.E., M.D., F.R.C.P., F.R.C.S., F.R.S., I.M.S. Third Edition. London, 1919: Henry Frowde, Hodder and Stoughton. Pp. xii + 404. Price 30s. net.

It is with pleasure that we receive a new (the third) edition of Sir Leonard Rogers's well known book on Tropical Fevers. Eight years have elapsed since the publication of the last edition, but so rapid has been the progress of our knowledge of tropical diseases that numerous additions and alterations have been rendered necessary. A considerable proportion of the new and additional matter is the outcome of the author's own observations, particularly in the section dealing with kala-azar and its treatment by the intravenous administration of antimony salts. More recently, Sir Leonard Rogers has brought to notice the advantages of colloid antimony sulphide in the treatment of kala-azar as compared with sodium antimonyl tartarate, the salt which has latterly been most extensively used.

The book has also been largely re-arranged, and in doing so opportunity has been taken to distribute the section on blood examination under the appropriate diseases; a much more satisfactory arrangement. The historical introduction and the section on epidemic dropsy, which is now considered to be identical with beri-beri, and the section on liver abscess are altogether omitted, the latter already appearing in the author's book on dysenteries. There is a good section on quinine administration in the treatment of malaria, and it is interesting to note that a practitioner of Sir Leonard Rogers's knowledge and experience considers moderate doses of quinine (thirty to forty-five grains per diem) given by the mouth as an efficient routine method of treating most malarial infections, despite the views of some recent writers, who as a result of experience in certain areas of the war advocate much larger doses as a routine measure. We consider Sir Leonard Rogers's book to be a sound guide for all who desire a knowledge of tropical fevers and their treatment, and the fact that it is largely based on his own work materially adds to its interest and value. The large number of temperature charts add to the usefulness of the book, which is well printed and has not been allowed to become too unwieldy in size.

O. L. R.

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Original Communications.

NOTES AND COMMENTS UPON MY MALARIA EXPERIENCES WHILE WITH THE EGYPTIAN EXPEDITIONARY FORCE, 1916-1918.

BY H. M. WOODCOCK, D.Sc.LOND.

Fellow of University College (Acting Head of the University Department of Protozoology).

(*Continued from p.* 396.)

(2) SEVERITY OF INFECTION: THE QUESTION OF DIFFERENT "STRAINS"

As I have had experience of malaria only as it occurs in Egypt and Palestine, I am unable to say how the malignant tertian infections of the latter country compared with those of Macedonia, for instance, in regard to the severity of the attacks and the danger to life, amongst the British troops. The experience of someone who has been through a season of malignant tertian both in Macedonia and in Palestine would be required to answer satisfactorily the question whether this type of malaria was, on the whole, really more severe in its effects in the former country than in the latter. There is, perhaps, one point which should be taken into account. The medical authorities in Palestine had the advantage of the knowledge of what had been met with in Macedonia and were to a certain extent forearmed; hence it is probable that the more rapid institution, generally, of treatment by injections as early as possible in the history of the case resulted in a smaller percentage of fatalities in Palestine than occurred in Macedonia. However this may be, the effects of malignant tertian, as it attacked our troops in Palestine, were sufficiently serious and undoubtedly much graver, as a whole, than those of the same type as it was met with in the Southern Canal Zone.

It has been suggested that there are different "strains" of this parasite,

the malarial attacks produced varying in severity according to the particular locality. Difference in the virulence of these different strains might stand in relation with the number of "passages" through human hosts, this being, of course, greater in heavily infected districts; or, again, it might possibly be to some extent associated with the transmission of the parasites by different mosquitoes in different geographical areas. The question is not one, it is to be noted, of definitely distinct species, or at least varieties, possessing differences in their morphological or developmental characters, such as are stated by some authorities to be present in a West African type of pernicious parasite. There were certainly no such differences of any kind to be noted as between the malignant tertian form in Egypt and that in Palestine; nor am I aware that any such distinctions have been observed in the case of the Macedonian type. The question is one, rather, of different, definitely established *races* of the same specific form of parasite, producing normally malaria of different degrees of virulence.

Now, at any rate as regards a comparison of the disease as it occurred in the Southern Canal Zone and in South Palestine, I think that the difference in the severity can be fully explained on other more general biological grounds, without the necessity of having recourse to this view. In the first place, there is the degree of heaviness of the infection, i.e., the number of sporozoites inoculated. This in turn is directly dependent upon the number of infective mosquitoes biting the same person within a short period, and upon the extent to which the mosquitoes themselves are infected. Naturally, in a malarious district, thickly populated with mosquitoes, there is much more likelihood of a person being bitten by more than one infective mosquito, on the same or on succeeding nights, than there is in a district where the mosquitoes are less numerous and themselves infected in a lesser proportion.

Again, the degree of the infection in an individual mosquito may vary greatly. This point has been brought out clearly by Roubaud (*loc. cit.*). There may be only very few oöcysts developed on the stomach-wall, with, consequently, a relatively small number of sporozoites in the salivary glands subsequently; or there may be many oöcysts, and the glands be subsequently packed with sporozoites. In addition to the question of the available supply of gametocytes, i.e., the number taken up by a mosquito when feeding on a malarial person, the strength of the infection depends: first, on its particular idiosyncrasy; one mosquito may be more resistant to, or less suited to the successful development of the parasites than another. Secondly, and this is, according to Roubaud, a most important factor, on the nearness to which the temperature at the time approaches the optimum for the development. With a temperature slightly removed from the optimum, fertilization and sporogony may still proceed in the case of some of the parasites, but be unsuccessful as regards many.

I suggest that these various conditions operated to a much less favourable degree—from the point of view of the parasites—in the Southern

Canal Zone, in the autumn of 1916, than they did in South Palestine in the autumn of 1918. It has already been seen how small, considering the season, was the proportion of malignant tertian among the British troops in the former district.

Further, as regards the type of the disease, there were extremely few cerebral or other dangerous cases in the Canal Zone. So far as I am aware, there was only one British fatality, and in this case the diagnosis was not made until after death. Had this malignant tertian been of a specially dangerous type, there would have been many more grave cases and fatalities, because (at this time) injections of quinine were not being given.

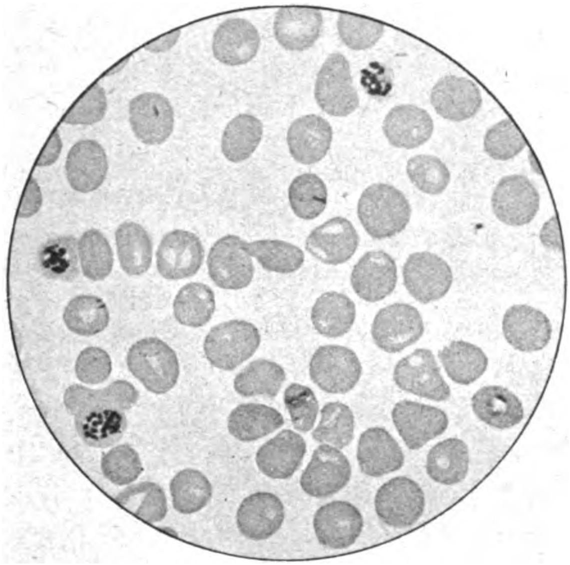

FIG. 7.—Microphotograph of a field from a smear showing active sporulation of the malignant tertian parasite in the peripheral blood. × 900. In the field, three parasites are seen in which nuclear multiplication is advanced, and four young forms are present. While it is not uncommon, in heavy infections, to find an odd rosette or two, stages in active sporulation were met with twice only. This figure is from one case; in the other, numerous solid, growing forms were present, several of which were commencing nuclear multiplication.

(This microphotograph was very kindly taken for me by Dr. Norman, at the King George Hospital.)

I am strongly inclined to associate the difference in the severity of the attacks, as a whole, in the two districts referred to, directly with the difference in the numerical abundance of the parasites in the two sets of cases, as apparent from the examinations of the blood. It is true that I wrote, in my paper in 1917 (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. xxix, p. 300), that "in all the British malignant cases, the parasites (in the ring-form) were frequent or numerous, whereas the contrary was often the case among the Indians." So they were, according to my experience up till then, and especially by comparison, relatively, with their number in

the Indian cases. But it was not until I came into contact with Palestine cases that I learnt what heavy or abundant infections meant. The number of parasites present in the blood in these latter was *uniformly greater than* in the cases examined at Suez. Frequently, in fact, as soon as the objective was in focus, one or often more parasites were seen. It was, indeed, fortunate for us that this was the case, because, on many days at Jerusalem, for instance, there were over 300 examinations to be made. The time was occupied mainly in searching for benign tertian infections (at times very scanty) and in eliminating the negatives.

In my experience, there was rarely any difficulty in diagnosing a fresh malignant case, on account of scarcity in number of the parasites, *provided the film was well made and well stained, and one knew exactly what to look for*. (Even at this day, I do not think a reminder of this proviso is altogether unnecessary.) Sometimes the parasites are present mostly in the form of minute rods or streaks, attached to the edge of the corpuscles (the so-called "appliqués" forms); when this is the case, unless the film *is* well stained, they will be missed. I recollect an instance which occurred while I was at Jaffa. A patient was brought into the casualty clearing station, unconscious and seriously ill; a blood examination was immediately made and I was surprised that I could find no parasities, as the case was almost certainly one of malignant malaria. Somehow, I did not feel quite satisfied with the appearance of the staining, so I went and took another film, in which I at once found numerous parasites, just of this type; and the patient then received his intravenous injection.

While at Jerusalem, we had numerous repeat examinations, sent in a day or two later, when the clinicians were not satisfied with the negative result of the first. For our own edification, we noted all the occasions when such a repeat proved positive, after the first examination had been negative. Only on two occasions, out of over 1,200 cases of malignant tertian, were the parasites first found at this second examination. Hence I think we missed extremely few of these cases; as I have indicated, it was, generally speaking, impossible to do so. I myself never encountered a case in which the patient was seriously ill and the parasites were anything but numerous in the blood. (I have seen the converse, where a patient had numerous parasites in the blood and was walking about at the moment; though he was far from being able to do so an hour or two later.)

It is quite otherwise, however, with benign tertian infections. I have known a fresh case, where the patient had typical attacks of benign tertian fever, at about forty-eight hours' interval, the temperature rising almost to 105° F. each time; and it was not until between the second and third attack that I could find any parasites, although at least four examinations had been made previously. Again, in the repeat examinations alluded to, we found benign tertian parasites when these had not been observed at the first examination, on quite a few occasions; and I should have far more hesitation in saying that we did not, as it were, miss a few, than I have with regard to malignant tertian infections.

It is, of course, well known that a person may have quite a sharp attack of benign tertian fever and yet the parasites may be remarkably scanty and difficult to find.[1] But from all my experience, it is just the opposite with the malignant tertian form (I am referring to fresh, not chronic cases, it must be remembered). And the point I wish to emphasize is that the severity and danger of a malignant tertian attack are, *in general*, directly proportionate to the numerical abundance of the parasites.

There is another factor to be taken into consideration. In Palestine, and the same applies equally to Macedonia, we had large numbers of men suddenly plunged into a highly malarious country. These men were, for the most part, entirely unaccustomed to malaria; in contrast to the indigenous population, which must to a large extent possess a certain degree of acquired immunity, or at any rate resistance to malaria. It is reasonable to suppose, therefore, that this provision of fresh, unused material as a "nutrient medium," had (temporarily) a stimulating effect upon all the activities of the parasite.

Lastly, the protean guises under which severe attacks of malignant tertian malaria may manifest themselves are all set forth in the text-books of tropical medicine; most of these forms, e.g., comatose or cerebral, bilious remittent, dysenteric, came under my notice at one time or another. But no new type or variety was seen; nothing of which the exact picture could not be found in a clinical description, or with which those accustomed to malaria in the tropics would be unfamiliar.

To summarize the matter, I do not think there is any need to assume the existence of specially virulent races or strains of *Laverania malariæ* in different malarious districts of the Mediterranean basin. In my opinion, the severity of the malignant tertian, in a large proportion of the cases amongst our troops in Palestine, can be adequately accounted for on these two grounds: (1) heavy infections with the parasites, as a result of most favourable conditions for their development and prevalence in the mosquitoes; and (2) the susceptibility of the unaccustomed human host.

(3) The Treatment adopted for Malignant Attacks.

It may not, perhaps, be out of place for me to say a little upon this subject, because I was greatly interested in it. I was able, on many occasions, to check the results upon the parasites, of the treatment adopted; and I was enabled, by the kindness of several of the medical officers, who placed their clinical experience and notes at my disposal, to follow the cases.

1 This may often be due to the fact of the patient having had quinine, either prophylactically, or for treatment, in insufficient dosage. There can be little doubt that oral quinine has, for some reason or other, more temporary effect upon a benign tertian infection than upon a malignant one.

While at Suez, I had been greatly impressed by reading one or two articles on the success of, and, indeed, absolute necessity for, the intravenous administration of quinine in dangerous cases occurring in Macedonia. It seemed most advisable, in all severe cases of malignant tertian, to attack the parasites as quickly and as vigorously as possible. It was obvious, on general grounds, that the more rapidly the parasites were destroyed and the capillaries freed from the masses blocking them, the better it would be for the patient; and it was apparent that the question of time was often one of vital urgency. There could be no reasonable doubt, moreover, that a successful result would be produced more rapidly and effectively by the intravenous than by any other method of injection.

I knew, further, of these two general recommendations, the one from a sound text-book of tropical medicine (Castellani and Chalmers), the other from the "Memorandum" on medical diseases in the Mediterranean war area. "In cases of pernicious infection with subtertian parasites, no delay should be made in giving the patient an intravenous injection"; and, again, "in pernicious infections and comatose cases the intravenous route is undoubtedly that to be preferred." In short, the importance of this method impressed me so strongly that I decided, should I at any time come into contact with pernicious forms of malaria, I would venture to urge its adoption wherever possible, provided, of course, that there were no counterbalancing disadvantages, either with regard to the actual administration or the immediate consequences, in giving the drug by this method. It seemed to me that when clear and definite counsel upon a particular matter was given by recognized authorities on the subject, others less experienced might do worse than endeavour to follow, so far as possible, their advice. Otherwise, of what use is it to publish treatises, issue memoranda, and so on?

Early in November, 1917, severe cases of malignant tertian began to arrive at Kantara. Thanks to the willing assent and co-operation of the medical officers of wards admitting malarial cases, I was able to see the method tried; and I would particularly mention in this connexion Captains A. MacDonald and Wyborn, who adopted it on several occasions. I did not at this time keep any notes of the cases in which intravenous injections were given, and with what results. Some were, I know, most successful; but there were, unfortunately, some fatalities, in spite of all our efforts. The reason was that most of the patients so treated were admitted in too grave a condition, i.e., too late for any treatment to save them; hence the method hardly received a fair trial. This much may be said at once, however, and the point will be emphasized again; no harmful or untoward effects were observed as a result in any way of this method of administration.

There were at first two adverse factors to contend with. For one thing, many medical officers had had, naturally, little or no experience up till then in the diagnosis and treatment of malaria. And only too many cases arrived down, either undiagnosed or wrongly diagnosed, and, of course,

having had no quinine. We soon learnt that if a patient had gone for eight or nine days with a severe "bilious remittent" attack untreated, it was almost impossible to save him. The trouble was that the equally grave (ultimate) danger of this type was not at first recognized so early in the history, as in the more obvious cases of the "cerebral" type.

Secondly, there was a pronounced impression prevalent in some quarters—an impression which I found still persisting when I got up to Jaffa in February—that injections, especially intravenous ones, were dangerous and only to be given as a last resource; when, as a matter of fact, they were usually too late to be of success. There was still at first too great a tendency to rely on the old method of oral administration. However, it soon came to be realized—what might, indeed, have been reasonably anticipated by anyone who knew anything of what had been happening in Macedonia—namely, that oral administration, in cases of malignant malaria, in another known equally malarious country would be absolutely futile, in fact, worse than useless. Thus, in the end, the "oralist" school, at any rate, lost all support as regards malignant tertian in Palestine.

But to return to Kantara. In view of the above circumstances, Captain Stuart and myself thought it would be advisable and useful to send up a memorandum on the subject to the high medical authorities. In this we pointed out what had been occurring and made the following suggestions which seemed to us, so far as we knew at the time, the best that could be recommended. That, wherever possible, cases of P.U.O. or P.N.Y.D. should have blood-films examined up the line and not be allowed to go eight or nine days without such examination. That, where immediate blood-examination was impracticable, such cases should at once be started upon a course of ten grains quinine morning and evening, until a definite diagnosis could be made. (This was in the hope that the parasites might be kept in check and a dangerous condition prevented from arising; but in the light of after events, I should say that oral quinine appeared to have *little or no effect*, even in this direction, in severe British cases of malignant.) That all cases diagnosed as malignant should at once be given quinine by the intravenous route. We recommended as follows: (*a*) 12 (or 15) grains of the bihydrochloride [the ampoules generally available were of 6 grains each] in 10 or 20 cubic centimetres of sterile saline, injected into the vein with due precautions. The solution should be injected slowly, taking about half a minute for each cubic centimetre. This was to be given on two successive days. (*b*) In addition [because we did not think that amount of quinine, of itself, enough] fifteen or twenty grains of the same solution to be injected intramuscularly, preferably in the buttock, twice daily, for four days; that there should be five or six hours' interval between the intravenous and the intramuscular injections; and subsequently, oral administration in the usual way. In conclusion, we urged the necessity for as rapid a diagnosis and as early treatment of these malignant cases as possible.

I was further emboldened thus to advocate the general adoption of the intravenous method because, just at this time, I received a copy of the paper by my friend Dr. J D. Thomson ("Notes on Malaria," JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, October 29, 1917), dealing with his experiences in regard to intravenous injections. Here, Thomson shows clearly not only the great success of this method, as a routine measure, but also the absence of danger or risk in connexion with it, provided, of course, that the ordinary precautions are taken. It may be asked, why, when I thought so highly of the intravenous method, did I recommend the combination of intramuscular with intravenous injections? Mainly, it must be admitted, as a compromise. I did not think that one dose of (say) twelve grains intravenously, on two successive days was, of itself, sufficient; more especially if a real endeavour was to be made to stamp out and eradicate the infection at the start—the best chance, of course, of preventing recurrences. And I had seen for myself the actual difficulties in practice, as things were. The only needles generally available were those belonging to ordinary syringes, large and stout and with a relatively wide bore, and the best had to be made of these. Further, the vein of a patient seriously ill was often flaccid, difficult to see and still more difficult to get into. Hence I thought it would be as well, perhaps, not to recommend more intravenous injections than were absolutely necessary; though probably, the earlier the case was treated, the less frequently would the latter difficulty arise.

A fortnight or so after sending up our memorandum we had the satisfaction of receiving an official circular, issued with the authority of the (acting) Director of Medical Service at that time, dealing with the subject; and as this was by far the best guide to treatment, and, indeed, the only officially signed recommendation that I ever saw circulated, the following extracts from it are given. First came a brief description of the principal types of malignant tertian. The memorandum continued: "In advanced units where laboratory facilities are not available, every case of pyrexia should be viewed with suspicion, and it is advisable to commence treatment with quinine even before evacuation to a casualty clearing station. Fifteen grains twice daily by the mouth is recommended. As soon as possible after arrival in the lines of communication, a blood examination should be made in every case. As soon as a definite diagnosis of malignant malaria is made, quinine should be at once administered. The intravenous is considered to be the most rapidly effective method of administration. The dose recommended is ten grains of the hydrochloride or bihydrochloride, in ten cubic centimetres of sterile saline, twice or three times in twenty-four hours, injected slowly, allowing ten to thirty seconds for the injection of each cubic centimetre. This should be repeated on the second day. If symptoms are not so urgent, 10 grains in 10 cubic centimetres saline, injected intravenously, and 20 grains in 10 cubic centimetres saline, injected intramuscularly, six hours later, may be employed. From the third to the sixth day of treatment, 15 to 20 grains in 10 cubic centimetres saline should be injected intramuscularly, twice

daily, into the buttocks, deltoid, or other suitable region. Scrupulous attention to the sterilization of instruments and solutions is essential in carrying out both intravenous and intramuscular methods. Cases of tetanus have arisen subsequent to treatment."

In this important memorandum then, we had clearly indicated: (*a*) the urgent necessity for as rapid diagnosis and treatment as possible; and (*b*) the definite sanction and recognition of the value of the intravenous method. Nothing was said as to there being any special danger in this method, apart from obvious dangers which might arise unless attention was paid to sterilization. Sterilization was of course equally necessary in the intramuscular as in the intravenous method; indeed, one might think there would be, if anything, more risk, as regards tetanus, by the former method.

I can only say that, in my opinion, had these instructions as to treatment been periodically repeated and generally acted upon, there would have been fewer fatalities than did, unfortunately, occur in the subsequent season.

As a result of the realization of the necessity for early diagnosis, special malarial diagnostic stations were established by Bahr in connexion with certain field ambulances, which did *excellent* work. But as regards the most valuable method of treatment, the above recommendation seemed rapidly to become a dead letter. I never saw it, or heard it referred to at all up the line. This may have been because the (acting) Director of Medical Service at the time soon afterwards left. At any rate, when I arrived up at Jaffa, I found there was still a widespread impression that intravenous injections were most dangerous; so much so that I was told that no medical officer was allowed to give one without the express sanction of the officer commanding.

As stated in the first part of this note, malignant tertian quickly died down, and it was not until the end of June that the question again became urgent. As soon as fresh cases of malignant malaria began coming in, the officer commanding the combined clearing hospital to which our laboratory was then attached was good enough to ask Captain Stuart and myself for our opinion, and we repeated the recommendations we had previously sent up. (See above.) The line of treatment proposed was sanctioned, subject, of course, to the view of the medical officer in charge of the malarial wards as to any particular case.

Captain Nicholson, R.A.M.C., had the care of most of the British malarial patients at this time, and he was most willing and anxious to test the intravenous method. We intended to have a series of test cases, some of which were to receive the combination, and others only intramuscular injections. We were not able, however, to carry out this idea to any extent. Naturally, the worst cases at once received what we felt to be the best treatment—i.e., the combination: and, before we had many opportunities of making a definite comparison, Captain Nicholson had to leave for India. He very kindly gave me permission to use such clinical

notes as he had been able to take up till then, if I desired to; and I wish here to express my great thanks to him for his eager and valuable co-operation. He gave *many* intravenous injections *most successfully, and in no case was there the slightest untoward result.* All the cases so treated recovered, usually rapidly, and some of them were seriously ill on admission. We asked several of these patients to have a blood-test or two taken a fortnight or three weeks after they had passed on down the line, and to let us know the result. We heard from seven or eight subsequently; in every instance the examination had been negative, and the patient had had no return of malaria up to date. This period was, of course, too short to enable one to say with certainty that no relapse would occur; but it was almost impossible to follow up the cases for any length of time after they had passed down to the base. I append brief histories of some of the more serious cases, as examples. In all there was a heavy infection with the parasites. Captain Nicholson sometimes preferred to give an intramuscular injection first, following this with an intravenous one a few hours later. Calomel, usually three grains, was given soon after admission, and repeated as necessary.

(1) G——e.—History: New case. Diagnosed malignant tertian by malarial diagnostic station. Quinine twelve grains intramuscularly in field ambulance. June 25, 1918: 5 p.m., admitted. Diagnosis confirmed. Quinine, ten grains intramuscularly. 10 p.m., patient drowsy, incoherent, breathing slightly stertorous. Quinine twelve grains intravenously. 26th: 10 a.m., patient very much better; no headache. Parasites less numerous, but still fairly frequent. Quinine twelve grains intravenously. 7 p.m., quinine ten grains intramuscularly. 27th: 10 a.m., patient better. No parasites found. Quinine ten grains intramuscularly; evening, ten grains intramuscularly. (Ten grains oral during day.) 28th: quinine ten grains intramuscularly and ten grains oral t.d.s. (patient vomited one dose). 29th: 9 a.m., ten grains oral. Blood examination negative. Patient evacuated to base.

(2) S——y.—History: New case. Fever three days. Severe headache. Vomiting. Delirious since in field ambulance. Quinine five grains intramuscularly [!]. N.Y.D. June 30: 5 p.m. (on admission) patient deeply unconscious, breathing slightly stertorous; flushed; pupils small. Diarrhœa with incontinence. Vomits everything. Diagnosis: malignant tertian. Quinine (6 p.m.) twelve grains intravenously. 8 p.m., pulse 100, good, full. 11 p.m., quinine intramuscularly ten grains. July 1: 10 a.m., patient conscious, but diarrhœa and incontinence, with bilious vomiting. Quinine intravenously twelve grains. 2 p.m. and 7 p.m., quinine ten grains intramuscularly. 2nd: 10 a.m., patient sits up, comfortable. No incontinence or diarrhœa. Blood examination; no parasites at all found. Quinine ten grains intramuscularly (and ten grains oral t.d.s.) 3rd: 10 a.m., patient better. Blood examination; one or two rings found, Quinine ten grains intramuscularly and ten grains oral t.d.s. Evening,

quinine twelve grains intravenously again. 4th: 10 a.m., quinine ten grains intramuscularly and ten grains oral t.d.s. No parasites found after good search. 5th to 7th: quinine ten grains oral t.d.s. On latter date blood examination again negative and patient evacuated to base.

M.		100·2	100	100	N	N
E.	104·8	101·4	101·6	101	99	N
	June 30	July 1	2	3	4	5

(3) W——n.—History. New case. Ill thirty-six hours. Headache, dizzy, pain in stomach, diarrhœa and frequent vomiting. No rigors or sweats. N.Y.D. July 7: 1 p.m. (on admission). Looks ill; constantly groaning, drowsy, apathetic. Diagnosis: malignant tertian. Quinine ten grains intramuscularly. 5 p.m., quinine twelve grains intravenously. 8th: 10 a.m., patient feels better. Quinine intravenously twelve grains. Afternoon, quinine ten grains intramuscularly. Also oral, ten grains t.d.s. (vomited two doses). 9th: 10 a.m., patient had slept badly; much pain in stomach. Blood examination: no parasites found. Quinine ten grains intramuscularly. Patient vomited twice during morning. Dover's powder ten grains noon. 5 p.m., quinine 10 grains intramuscularly. 10th: patient had slept well till 2 a.m., then had much pain in stomach. Feels better this morning; quinine ten grains intramuscularly morning and evening, also oral, ten grains bis. Also Fowler's sol. t.d.s. 11th: Morning, patient better. Again no parasites found. Quinine, one injection, ten grains intramuscularly and bis per os. 12th: quinine as for 11th. 13th: Blood examination again negative. Evacuated to base.

M.	104·2	98·6	100	100	97	N	98	N
E.	100	99·8	100	N	97	99	N	N
July	7	8	9	10	11	12	13	14

(4) S——n.—History: Malaria in Salonica. Twelve attacks altogether, last on May 17, continuing fourteen days (type unknown). Ill now for four days. Headache, pains all over, rigors and sweats; no diarrhœa, but frequent vomiting. N.Y.D. (This case proved to be a mixed infection of malignant tertian + quartan; the last was almost certainly a relapse. The former may have been also one of the few malignant tertian relapses we had.) July 9: (On admission) tongue furred; spleen + and tender. Nausea and vomiting yellow liquid. Patient looks ill. Diagnosis, malignant tertian. Noon, quinine twelve grains intravenously; also saline with brandy one ounce per rectum. 5 p.m., quinine intramuscularly ten grains. 10th: Quinine twelve grains intravenously and ten grains intramuscularly bis (much vomiting during day). 11th: 10 a.m., malignant tertian parasites still present, greatly reduced in number, but not scanty; quartan parasites also found, scanty. Quinine, one injection ten grains intramuscularly, also arsenic injections (iron cacodylate, twenty minims subcutaneously bis). Much obstinate bilious vomiting during day. Patient very anæmic and hæmolytic. Saline injections, mustard application. 12th: 10 a.m., patient

much better; vomiting stopped. Blood examination; no malignant tertian parasites found; quartan parasites still present, scanty. No quinine. Iron cacodylate injections bis. 13th: Morning, patient much better; no vomiting. Quinine ten grains intramuscularly bis. Arsenic injections t.d.s. 14th: As 13th. 15th: Morning, blood examination negative. Quinine one injection ten grains intramuscularly and ten grains oral bis. Arsenic t.d.s. Patient was evacuated to base a day or two later.

M.	102	N	100	100	N	99	N	N
E.	103·4	102	101·6	99·6	100	99·4	99	N
July	9	10	11	12	13	14	15	16

The other cases before Captain Nicholson left were mostly of the more ordinary kind, i.e., without cerebral symptoms, or obstinate bilious vomiting. As stated, some of these were treated with the combination (intravenous + intramuscular), and others with intramuscular injections only. These patients did very well by either method. This much, however, can be said: It was noted that, in general, the temperature came down to the normal at least a day or so earlier when the former method was used; and also, the parasites disappeared from the blood a day or so sooner. Once or twice, where the intramuscular method alone was used, crescents were subsequently observed in the peripheral circulation, when no rings could be found; this indicated that the infection was still present in the internal organs. I *never* found crescents to develop in any case treated by intravenous injections. This is an interesting and important fact, so far as it goes, but of course the experience was not on a large scale.

I had also one or two other experiences—sad experiences of vain struggles—subsequently, the details of which cannot be given here. While at Jerusalem, the laboratory was not directly associated with any hospital, and I had neither the opportunity nor any possible time for anything but routine diagnostic work. As a result of my malarial experiences, of all that I saw, knew and heard, I left Palestine with the firm conviction that in dangerous cases of malignant tertian, where the patient may have been going some days untreated, the best chance of saving his life is to give quinine intravenously, in good doses. This may afford only a slight chance; all depends on how long the patient has been ill. But that this method will sometimes succeed, where intramuscular injections alone will fail, there cannot be, I consider, the slightest doubt.

There is another aspect of the question. Even as a routine method intravenous injections are not only preferable, because more efficacious, but there is less risk of untoward consequences as a result of the injection of the quinine. I never saw or knew of any trouble arising from an intravenous injection, but I have myself met with several cases where local muscle or nerve trouble has resulted from the use of the intramuscular method. I have indeed spoken with more than one Royal Army Medical Corps officer,

suffering thus after the last injection, who has declared that nothing would induce him ever again to have an intramuscular injection of quinine.[1]

While with Dr. J. D. Thomson, at the King George Hospital again, since my return from the East, we have had many cases of relapses of benign tertian from Salonica, and on two or three occasions there has been difficulty in overcoming the objection of new arrivals to an injection, because of the pain and suffering the men had previously endured as a consequence of intramuscular injections. Their feeling of relief at the entire absence of any subsequent pain or discomfort at the site of the intravenous injection has been marked.

I have had the privilege of assisting Thomson on many occasions; and by his method, *using a small, sharp needle of fine bore*, and following the procedure indicated in his article (*loc. cit.*), an intravenous injection becomes as simple and straightforward a matter as can possibly be desired. By this method, two intravenous injections of twelve grains each daily on two successive days, for instance, could be given without the least difficulty, and there would be no need whatever for any intramuscular injections. Personally speaking, from all that I have seen, I would much rather have an intravenous than an intramuscular injection; and I certainly should not care for anyone who feels himself unable to give thus an intravenous injection to give me an intramuscular one.

In conclusion, I hope that my friend may perhaps at some future time take an opportunity of publishing further details with regard to his method, and one or two slight modifications which he has adopted, and on the marked success resulting from its use in obstinate, chronic cases; because the method is, I consider, invaluable, and one which ought to be of the greatest assistance to all who have to deal with malaria.

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[1] A most instructive commentary on this subject is provided by a recent paper by Dudgeon (*Journal of Hygiene*, 18, 1919, p. 317), in which the harmful effects on muscle- and nerve-tissue that may result from intramuscular injections are clearly shown.

RELAPSING AND MIANEH FEVERS IN EAST PERSIA.

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My introduction to the lines of communication East Persia took place at Juzzak in Baluchistan, from which place marching with camels on the camel track Birjand was reached after covering a distance of 375 miles. During the march water was usually brackish, very often saline and at times extremely scarce. The little time there was to spare wearied after the march and the difficulties of obtaining water were not conducive to the cleanliness of the Indian follower and the major portion of the one day's halt after seven on trek during the cold weather was frequently spent by him in sleeping and keeping warm and not in performing ablutions.

When I arrived at Birjand, I was not surprised to find that special attention had to be focused upon vermin-borne diseases such as typhus and relapsing fevers. Troops were at that time living in Persian billets and were verminous. Instructions were issued ordering compulsory bathing, the issue of N.C.I. powder, regular regimental inspections and delousing of clothing, etc., by steam disinfection.

These arrangements had the desired effect and although accounts of outbreaks of typhus fever in Persian villages reached us from time to time, the troops except for odd cases kept wonderfully free from these diseases in spite of the unavoidable contact with the Persian.

At a later date I toured the upper sections of the line to Ashkabad and here heard tales of Amrani fever, of a disease called "strangers' disease," and that if travellers slept in certain *Sarais* and were bitten by not less than five bug-like creatures they usually died after very painful convulsions and much suffering. I could not get a clear account of the differences between Amrani fever and "strangers' disease," and therefore concluded they were probably the same and possibly relapsing or typhus fevers. In all of these tales I was very much interested and deeply regretted that the lines of communication of East Persia was not provided with a travelling laboratory.

On my return to headquarters at Birjand the weather was warmer, and I noted in my billet and in several others also that *Argus persicus* was present. A circular was issued to all senior medical officers ordering them to carry out special inspections of all cases of relapsing fever for the presence of lice, and if these could not be found to inspect billets from which the patients had come for the presence of *A. persicus* or the common bug. In all cases the presence of lice or possible contact with infected persons was proved, and the relapsing fever was of the ordinary type with which we from India were all well acquainted.

On March 18, 1919, a babu of the survey department was admitted to hospital under Captain Fry, I.M.S., at Birjand, with a history of a low irregular fever of some weeks' duration. He was lousy but had been living miles away from Indians in Persian villages. This low irregular fever continued for twenty-three days and he became anæmic, debilitated and much wasted. After several blood examinations a single spirochæte was found on March 12, 1919, in blood films taken from him. This type of chronic fever with a very few parasites was not at all like the relapsing fever of India and would appear to resemble the low chronic form of African tick fever. This fever was undoubtedly contracted in a Persian village and not from an Indian carrier.

On May 10, 1919, Captain——, 1/98th Infantry, was admitted to 9 B.S.S. at Birjand under Captain Walker, R.A.M.C., suffering from the usual type of relapsing fever, and he was found to be free from lice. On investigation it was found that he had a charpoy or Indian bed which had been left about in his compound and possibly used by servants, Persians, etc. A little over a week before he had taken this bed into use and had been very badly bitten by bugs. On examining a crack in the bed the woodwork was found to be full of bed bugs. The bed was burnt and eight days afterwards he developed relapsing fever. It is of interest to note the connection between "bed bugs" and relapsing fever.

With the outbreak of the hostilities with Afghanistan our line occupied a very exposed position running as it does for hundreds of miles parallel with the Afghan border; and this made it necessary for all camel convoys to be escorted by troops and led to an increase in the movement of troops on the lines of communication. The troops were also more frequently passing through villages and away from their posts which were now on a fairly good sanitary basis, special attention having been paid to the elimination of the Persian villager, whose body is a fruitful nidus for most diseases, venereal included.

On June 2, 1919, I was on a tour extending north as far as Meshed. When passing through Kain I was informed that out of a guard of thirty-four men of the 1/98th Infantry fourteen had been admitted to hospital with a fever of two or three days' duration. I visited the patients, amongst whom I found their company officer Captain Moore, an Indian jemadar, and a sub-assistant surgeon. They all seemed extremely comfortable, had normal temperatures but looked anæmic. They stated that they had suffered from fever with intense headache and pains in the limbs. I informed the officer commanding A/175 I.F.A., Captain Venugopal, I.M.S., that sandfly fever was prevalent down the line but impressed upon him the necessity for looking out for relapses in these cases. I wired to Birjand for stains and slides, etc., which were sent up by motor.

Next day after inspecting the post I continued my journey towards Meshed, inspecting the posts en route. On my return journey through Kain on June 25, I was shown the same cases by Captain Venugopal with

their temperature charts, etc., who stated that he could not arrive at a diagnosis in regard to them. He had treated them for malaria as they had rigors and sweats, but it produced no effect. He had examined the blood of all the cases during the rises of temperature for the presence of malarial parasites and spirochætes. He had been assisted in his examinations by Captain Bose and Assistant Surgeon Dolphin, but in spite of their combined efforts nothing had been discovered. On looking at the cases and case sheets I found that all patients had the same symptoms. They had recurring attacks of fever at irregular intervals, accompanied by severe frontal headache, pains in the limbs, etc., and followed by profuse sweats. The majority of cases had enlarged spleen, all looked anæmic, one had jaundice, and two bronchitis which became worse during the febrile attacks. I requested the Senior Medical Officer to transfer Captain Moore to No. 9, B.S.S. Birjand. I gave my opinion that the cases were relapsing fever of an unusual type and ordered repeated blood examinations to be carried out in spite of past failures; and at the same time requested that duplicate blood films taken from the cases should be sent to me at Birjand.

On my arrival at Birjand I saw Captain Walker, R.A.M.C., officer commanding No. 9, B.S.S., and pointed out the importance of Captain Moore's case and requested him to take blood films if he developed a rise of temperature. Two days after my arrival at Birjand a wire was received from Kain saying that a spirochæte had been discovered in a blood film taken from one of the cases. The same evening Captain Moore had a rise of temperature and blood films were prepared. The next morning a spirochæte was found in a film by Captain Walker, R.A.M.C. I visited the hospital and verified the presence of a spirochæte and made certain observations in regard to morphological differences between it and the Indian variety. Duplicate blood films taken from cases at Kain had arrived at Birjand and were stained and examined. Prolonged searches carried out by Captains Fry, Nambyar, I.M.S., and myself only resulted in finding spirochætes in two of the films. In Captain Moore's films after prolonged searches made by four observers one spirochæte only could be found in the first film and four in the second. The diagnosis was therefore confirmed and I made arrangements to tour north again in order to investigate the outbreak.

Investigation of Outbreak.

On July 15, I arrived at Kain and found that five new cases of the same disease had been admitted into hospital from different convoys. Proceeding with my inquiries in regard to the outbreak affecting Captain Moore's platoon, I found that the inspection of all these cases on their admission to hospitals had not revealed the presence of any lice. That they had escorted the up camel convoy for Turbat as far as Jainuk, changed over next day and brought the down connecting convoy to Kain. The only time that

Captain Moore, the Indian officer, sub-assistant surgeon and the men had been together was at the old Sarai at Jainuk on the night of May 20, and that between 27th evening and 28th morning all fourteen cases had developed fever. Taking it for granted that the incubation period of this disease was approximately the same in all cases, the fact that they all developed fever within twenty-four hours of each other pointed to an infection being acquired at one particular time and place and that the majority of the men of this small guard had been exposed to infection. At all other marching stages but Jainuk this platoon had occupied tents in camp, and therefore it may be presumed that under canvas it would be difficult for such a large proportion of men to be exposed to infection at the same time. I was informed that two platoons of the same regiment under an Indian officer had marched up with Captain Moore and his platoon to Jainuk and had marched on to Turbat next day. The men of these platoons did not enter the Sarai and no cases of fever occurred amongst them. On questioning the sick all thought that they might have been bitten by something at Jainuk, but the post-war Indian sepoy is not very bright and that is as far as I got until I spoke to No. 4867 sepoy Degram, No. 1331 sepoy Bhoora, and No. 4390 sepoy Ganga Ram. These men interviewed independently stated that they have been bitten at Jainuk by jayya (ticks). One of these men described the tick and drew it life size on the wall. They all described its slow movements and stated that it came out of the dust and slowly crawled upon them and that it did not appear for some time after their arrival in the Sarai and only towards evening when it scented human beings. They described the method of its removal from their limbs by plucking it out, as its head was buried beneath the skin, and stated that a swelling remained after removal Bhoora stated that he had removed fourteen to seventeen ticks from different parts of his body. The evidence of these men was very convincing. The first fourteen cases were now convalescent and owing to their progressive anæmia and debility, Captain Venugopal after failing to find spirochætes in blood films taken from them had found it necessary to give them injections of neosalvarsan. All cases had reacted to treatment and were well.

In regard to the five new cases one was a havildar of the 1/51st Sikhs, who had undoubtedly contracted his disease above Turbat. Three were Government camel sarwans from two different convoys who had contracted the disease below Turbat. The fifth was a dooly bearer of the hospital who had acquired this infection whilst in attendance upon Sub-assistant Surgeon Ghosh. The sub-assistant surgeon is included in Captain Moore's party. On admission to hospital no lice could be found on these men. The havildar admitted staying in Sarais at Kafir Kaleh, Asadabad and Khaimi, and I discovered later in Meshed that two of these places, Kafir Kaleh and Khaimi, had evil reputations. It is worthy of note that this havildar stated that he had contracted the same disease in Africa in 1917. On that

occasion the first attack of fever lasted for four days. Succeeding this he had an apyrexial period of five days and then a relapse. His blood was then examined and he was given an intramuscular injection into the buttock which cured him. If this is so it would seem that this Persian disease, although tick borne, may not be identical with African tick fever. The sarwans denied visiting Sarais, but as they were cognisant of the stringent orders that had been issued this was only natural. To men marching late at night and early in the morning and resting during the heat of the day, buildings are bound to be attractive when the temperature in the tents becomes high. On examining the blood films taken from the three sarwans and dooly bearer, I found that the spirochætes in them were similar in appearance to the ones observed in films taken from Captain Moore. Spirochætes were seen in the films taken from dooly bearer Kharke in relatively large numbers, but this is the only case in which fairly numerous spirochætes have been observed. This man had a very severe infection, was extremely ill, semi-delirious, and severe epistaxis necessitated the plugging of his anterior and posterior nares, as blood literally poured from his nostrils.

From Kain I toured to Jumin and found there the non-infected portion of Captain Moore's platoon. These men were paraded and questioned. They stated that they had entered the Sarai at Jainuk with the rest of the platoon, had thrown down their kits on the floor of the Sarai, opened their blankets, and laid down to sleep. After a time, towards evening, they noticed ticks crawling on to their blankets. They then went outside and picked the ticks off their blankets and slept in the open. They stated that they saw Bhoora remove sixteen ticks from his body and that as other men were being bitten they did not like the idea of sleeping inside. It did not occur to them to tell Captain Moore or the others who were asleep, in addition to which the Captain Sahib was sleeping in a tent inside the big dome and on a bed.

At Jumin I also saw Sub-assistant Surgeon Ghosh, who had received a neosalvarsan injection at Kain, was quite well and had returned to duty. He stated that he too had been bitten on the wrists by something at Jainuk and that Captain Moore had shown him two large swollen places on his leg with red punctured lumps in the centre, but that somebody had suggested that these were ringworm. Captain Moore at a later date informed me that he had noticed three red swollen elevated lumps on his body the day after leaving Jainuk. He had two on his leg and one on his neck, which were about ¼ inch in diameter. The centres of the lumps were red with a puncture mark in the middle. The periphery of the lumps was blue and they faded away like a bruise. These must have undoubtedly been tick bites.

I next visited Jainuk and found an old decayed Sarai with bricks all eroded and full of holes and the ground covered with very ancient litter. It had a dome like a mosque and it was under this that Captain Moore

pitched his tent surrounded by his men. Unfortunately, I could not stay here for the night but placed a towel on the ground. After two hours, although I changed the position of the towel to different parts of the Sarai, nothing appeared upon the towel, it being midday and these ticks nocturnal in their habits. On searching amongst the litter and bricks the shell of a dead *Argus persicus* with typical markings was seen suspended in a cobweb. I was now compelled to continue my journey to Turbat. A British orderly is, however, being sent down from Turbat to Jainuk, and it is hoped that he will be able to collect specimens with a view to attempting some experiments.

On arriving at Meshed I approached the British Consul-General, Colonel Grey, who very kindly placed his staff at my disposal. I learnt that these ticks were well known and feared and that their bites caused fever with hæmorrhages and frequently death. I was informed that the two most notorious Sarais were Kafir Kalah and Khaimi just north of Turbat. At one of these, nine years ago, three subordinates of the British Consular Staff had been bitten by these ticks. All developed fever, two died and one recovered. The man who recovered had hæmorrhages from the bowel and was ill for several weeks with irregular fever.

In the library of the British Consulate at Meshed is a book written by Eastwicke called "A Diplomat's Residence in Persia" by the late H. M. Chargé d'Affairs at the Court of Tehran, published in London 1864. In vol. ii, Appendix iv, is a very excellent description of the effects of bites and habits, etc., of *Argus persicus*, and a good illustration of this tick by Mr. W. H. Ince is portrayed. Eastwicke, in his description drawn from travellers' tales, quotes that M. le Baron Walchenaer described the fever due to the bites of *Argus persicus* in Paris in 1844, and that M. Fischer de Waldheim prepared a paper on this subject for the Academy of Moscow in 1823.

Dupré, quoted by Fischer, stated that a man who is bitten by these ticks falls into a consumption and dies. Treatment consisted of abstaining from fermented liquors, and sugar was a specific and preventive. This is interesting in the light of present-day treatment of some of the other types of spirochætosis.

Maurice Kotzebue described the dangerous bug of Mianeh, a village on the Tehran Tabriz road. He gave a good description of the tick and stated that it lived in old buildings, in which it could be found in very large numbers, and in these its bites were more dangerous. It was known to have infested Mianeh from time immemorial. He described its nocturnal habits, viz., that it feared the light and lived in holes in walls. In the winter it lay dormant but became active during the hot weather. He pointed out that it did not bite the local inhabitants, or at least if it did its bite had no worse effect on them than a bite of an English bug[1]. In

[1] Immunity as in African tick fever.

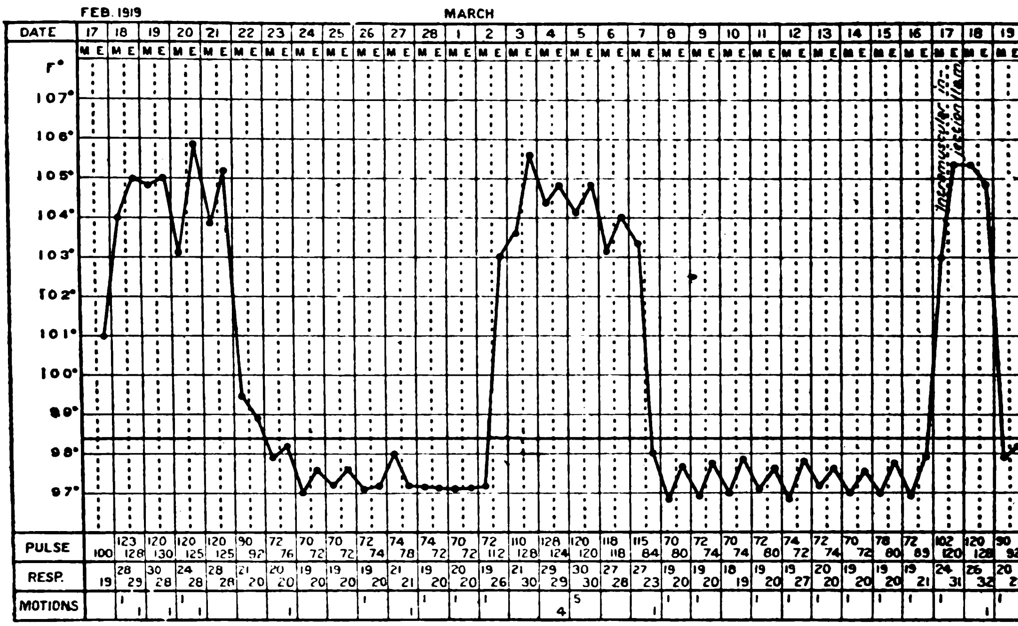


CHART 1.—Typical Indian type relapsing fever.

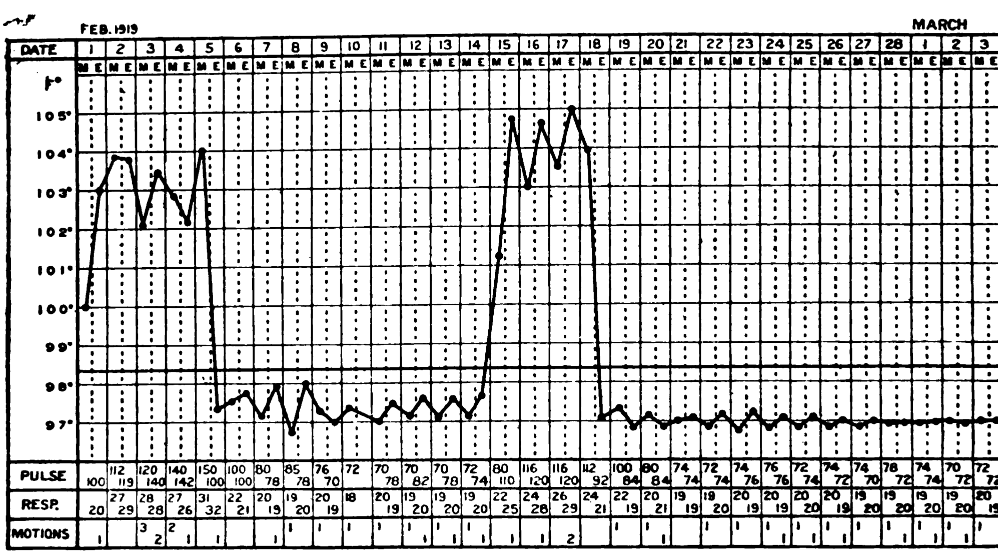


CHART 2.—Indian type relapsing fever—two relapses only.

revenge these creatures waged a cruel war against strangers [1] who had the misfortune to spend the night at Mianeh, and these unfortunates often died during the night. The English at Tauris (Tabriz) had unanimously stated that they had lost a servant after being bitten by these terrible insects; the bites in this case being followed by high fever, delirium, convulsions and death. These observations are stated to be confirmed by a no less reliable authority than Colonel Baron Wrède, whose Cossack orderly contracted this disease and died in agony. Treatment quoted in this article was to wrap the patient up in a still warm ox hide, and this usually effected a cure. The patient, however, should only drink sugar or honey and water for forty days. The paper went on to state that the local inhabitants could handle these creatures with impunity, and that it was extremely fortunate that they were not conveyed from place to place in their clothing or it would soon be disseminated throughout Persia. From this information there is no doubt that the *Argus persicus* has an extremely evil reputation.

These old records and the information given me by the Consular Staff at Meshed seem to indicate that the incubation period of this disease in some cases might be as short as one day. However, in the case of the fourteen men of Captain Moore's platoon the incubation period was seven to eight days and the dooly bearer who acted as sick attendant upon Ghosh developed the disease twelve days after the date of last exposure to infection.

Description of the Disease.

Incubation period one to twelve days. The attack commences with the same symptoms as Indian relapsing fever, viz., rigor accompanied frequently by vomiting, intense headache and pains in the limbs. The headache is frontal and often causes photophobia and this is very characteristic of the disease. In the case of the Indian variety of relapsing fever the temperature of the patient during the first attack usually remains at a fairly steady high level for five to six days with possibly one slight fall about the third day. After this initial rise of temperature there is almost invariably an apyrexial period of eight to nine days before the first relapse occurs.

In this Persian type of relapsing fever the first attack of fever may last anything from one to five days, usually three days, and the temperature of the patient is rarely as steady as in the Indian variety, the chart showing a very swinging type of fever with remissions which may touch the normal line. Profuse sweating accompanies the fall of temperature. The first apyrexial period may be anything from one to five days and is usually two days. The subsequent relapses rarely exceed forty-eight hours in duration and may last twelve hours only. They take place at fairly frequent but irregular intervals, the periods of apyrexia getting longer as the disease progresses. The largest number of relapses noted by us were seven and

[1] "Strangers' disease" of Eastern Persia.

these occurred within a period of forty-two days. In all probability many more would have been recorded if the disease in all cases had not been cut short by the administration of neosalvarsan.

During the course of the disease the patient becomes progressively weaker, anæmic, debilitated and wasted. Splenic and hepatic enlargement is usual. Between the relapses the patient feels well and is cheerful. Bronchitis and epistaxis were observed in two of the cases and jaundice in one case only.

The swinging irregular type of fever with short and irregular apyrexial periods and numerous relapses is diagnostic of the Persian variety and in this it is comparable to African relapsing fever, which is also tick borne.

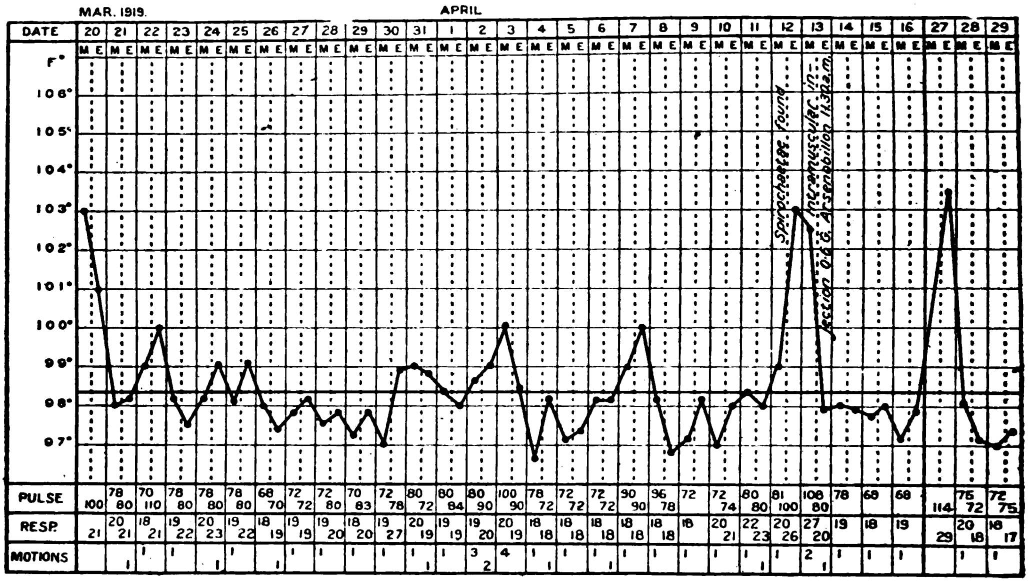


CHART 3.—Babu of Survey Department—(?) chronic type Persian relapsing fever.

DESCRIPTION OF SPIROCHÆTE.

In the majority of cases the number of spirochætes seen in any one blood film is much smaller than in the Indian variety and this is indicated by the number of examinations that had to be carried out before the discovery of the first spirochæte. Out of a total of nineteen cases and after prolonged searches by several observers spirochætes were only detected in eight cases. In fourteen of the cases, however, examinations of the blood did not take place until the first relapse and observations were cut short after the third to fifth relapse by the administration of neosalvarsan which the bad state of the health of the patient necessitated. The diagnosis of the cases in which spirochætes were not found was made on clinical grounds and the reaction of the patients to neosalvarsan confirmed the

diagnosis. The use of the thick drop method, using dilute Loeffler's methylene blue as the stain, which we have now adopted, would have undoubtedly given better results. In one case only were spirochætes

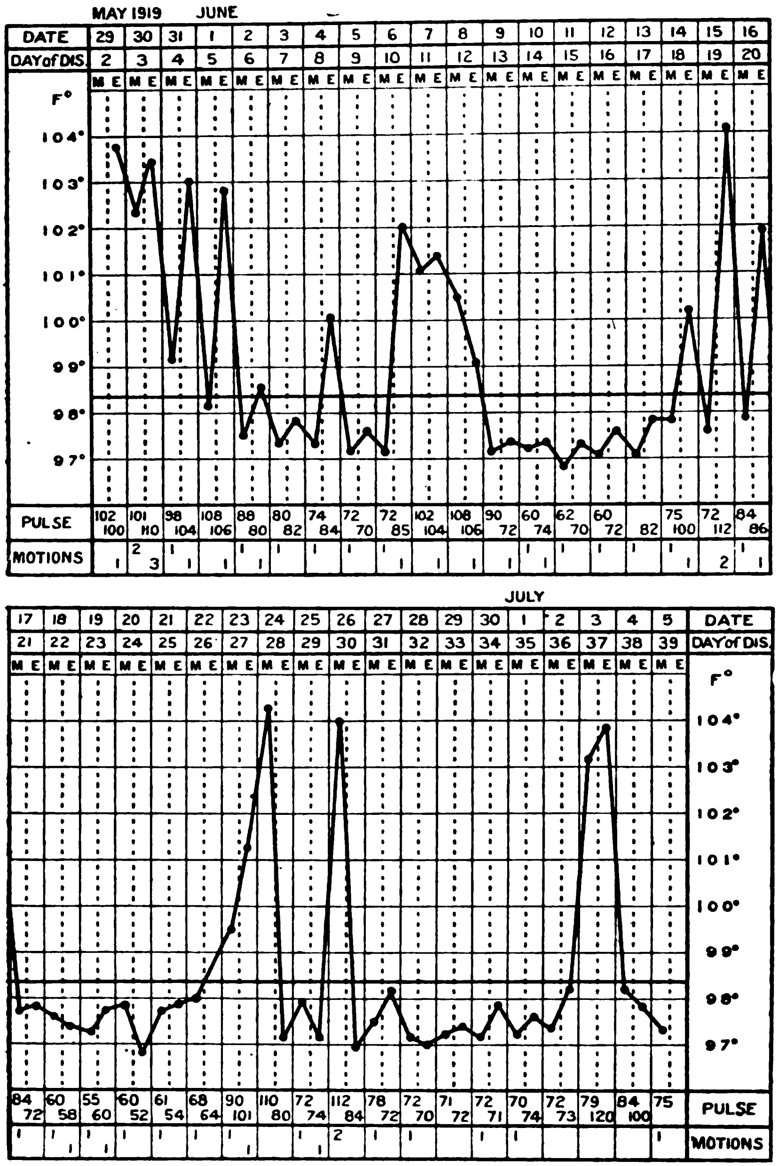


Chart 4.—Persian type tick fever.

found in fairly considerable numbers, and in this respect the disease resembles African tick fever, in which it is stated the spirochætes found are few.

The spirochæte may be said to be longer, a little coarser than the Indian variety and its spirals are more regular and deeper, the Indian spirochæte being less regular and possessing open flexures.

Its length without showing divisional characters averages eighteen to twenty-two microns and short forms are rarely seen. On one slide a spirochæte thirty-five microns in length was seen by me without any attempt at division being visible in the protoplasm. Figure of eight and loop forms are met with.

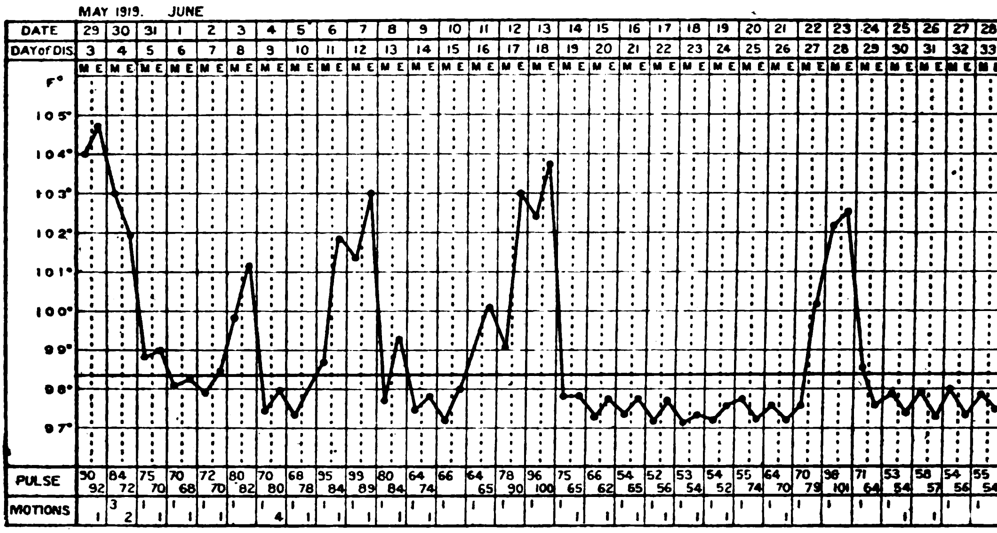


CHART 5.—Persian type tick fever.

It might be noted that although in length this spirochæte is comparable with the African variety it may be differentiated from it by the fact that it possesses fairly regular and deep spirals, whereas the African type is stated to have open flexures. It does not show however the extremely regular spirals which *S. novyi* is said to possess.

The characters of this spirochæte have received the confirmation of Captain Fry, I.M.S., Captain Walker, R.A.M.C., and Captain Venugopal, I.M.S.

Geographical Distribution of Disease.

Accurate information is extremely difficult to obtain in Persia. It is apparently thought that the Mianeh disease is more or less confined to Mianeh and district, but it is undoubtedly more widely spread. There is evidence to prove that it is known on the Tehran Meshed road and on the Eastern side we have the tales of "strangers' disease," tick bite fever, and Amrani fever. Amrani being an extremely filthy village in which *Argus persicus* is extremely common.

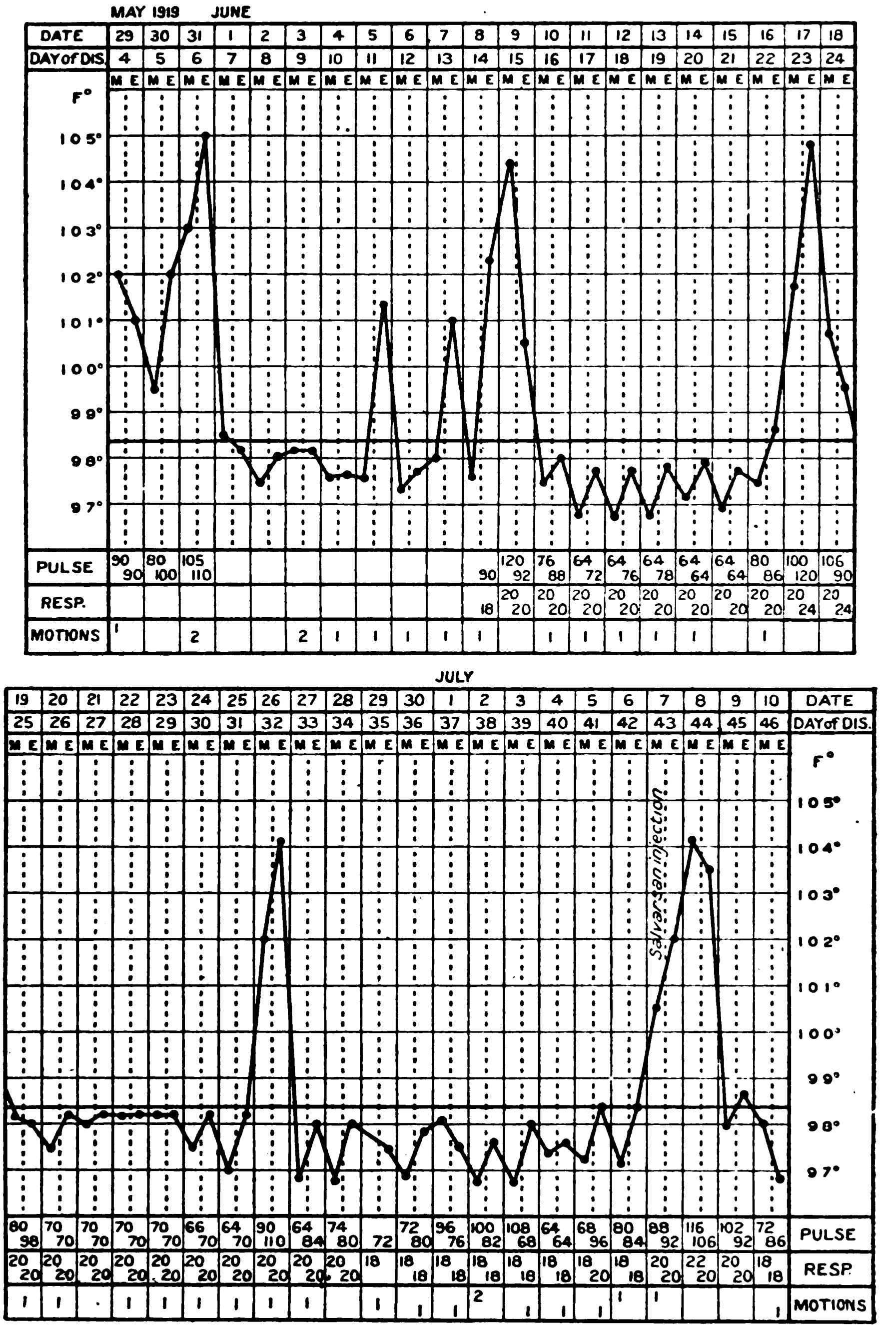


Chart 6.—Persian type tick fever.

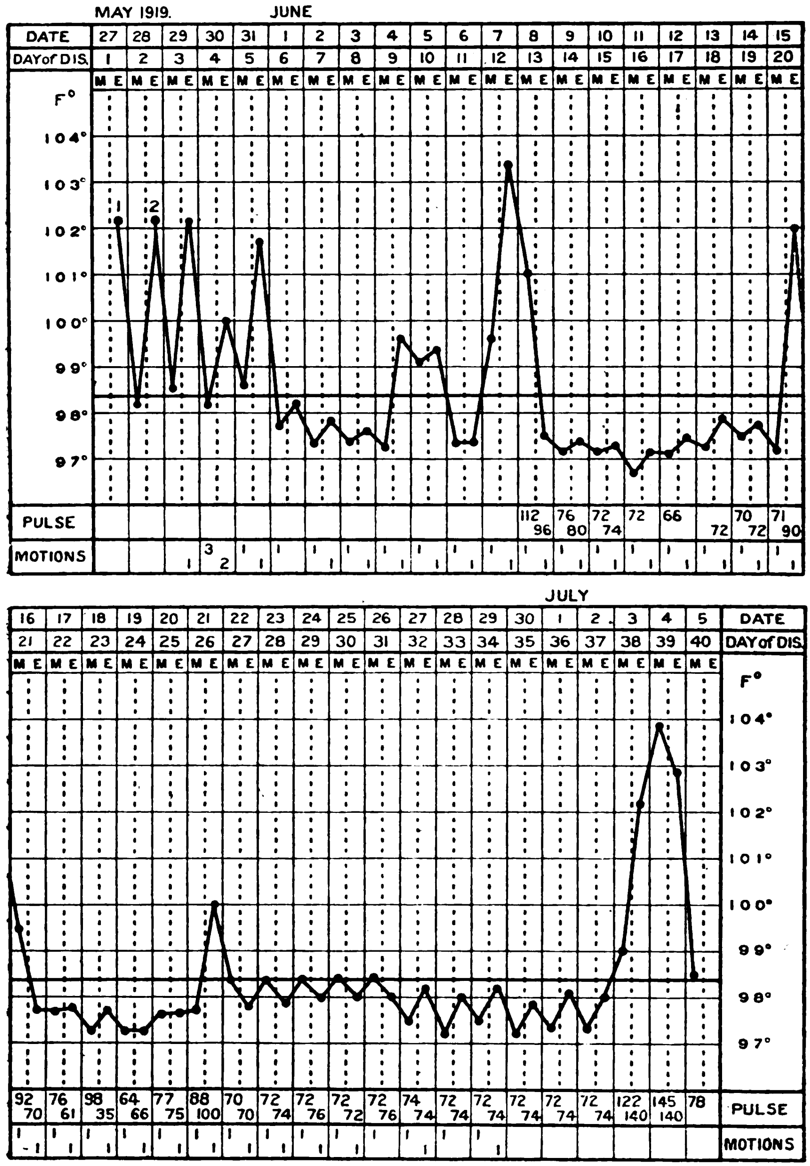


CHART 7.—Persian type tick fever.

All definite cases of this disease admitted to our hospitals have come from the lines of communication above Kain and always from down-coming convoys. In up-going convoys Indian relapsing fever has

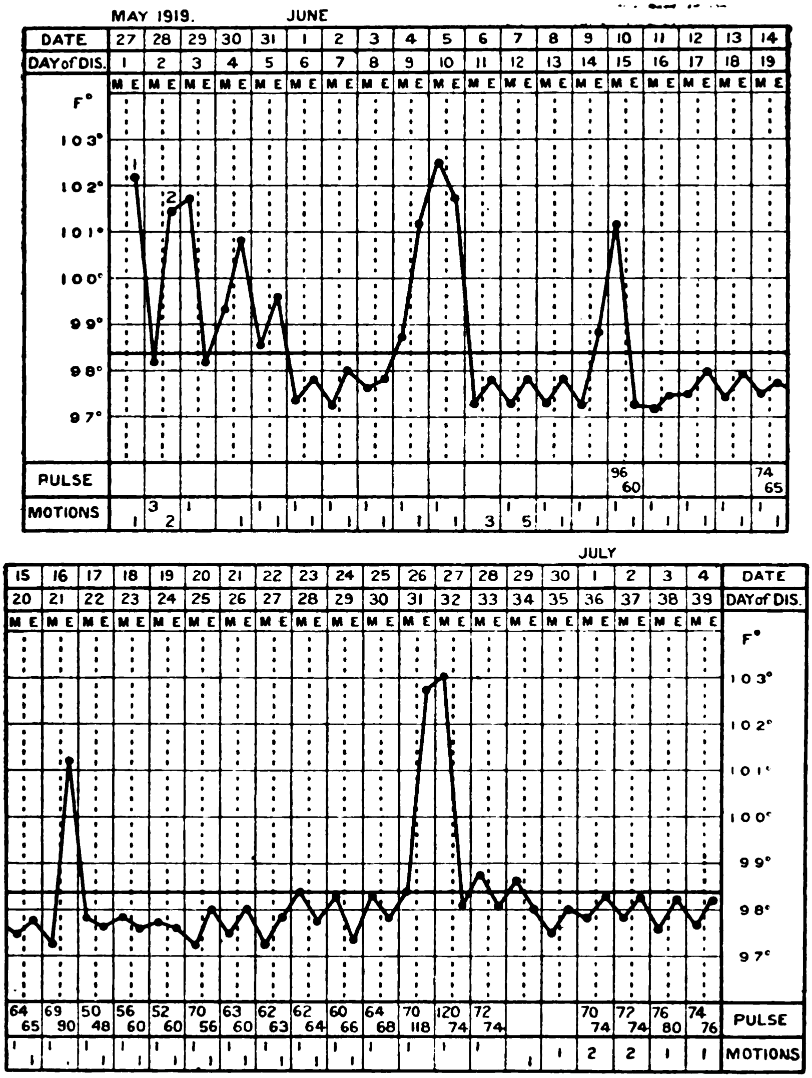


CHART 8.—Persian type tick fever.

only been found. All this points to this disease being endemic in the upper sections of the lines of communication above Kain and we have definite evidence from the Consular authorities at Meshed of infection of Kafir Kalah and Khaimi and the infection of Moore's convoy implicates Jainuk. It is possible that practically all old Sarais built of burnt brick are more or less infected.

All cases of relapsing fever admitted to hospital below Kain with one possible exception have been of the Indian variety and undoubtedly with exception of one or two cases louse borne.

In Meshed and also in Transcaspia during the winter of 1918-19 cases of Indian relapsing fever occurred amongst the Indian troops. These troops were frequently lousy and the spread of this disease was probably by means of Indian carriers and lice.

It was not until the warmer weather when ticks become more active and convoy duties due to the Afghan war brought our troops more frequently in contact with Sarais that this endemic disease of Mianeh or the relapsing fever of Persia showed itself.

I wish to acknowledge my indebtedness to Captain Fry, I.M.S., Captain Walker, R.A.M.C., and Captain Venugopal, I.M.S., who have kindly assisted me by placing their cases and hospital records at my disposal and also for carrying out numerous blood examinations at my special request.

I also wish to record my thanks to Colonel Boulton, I.M.S., A.D.M.S. Lines of Communication, East Persia, for his assistance by which I was enabled to carry out this investigation.

SOME DEDUCTIONS FROM A SERIES OF 243 MILITARY CASES OF CEREBROSPINAL FEVER IN THE LONDON DISTRICT WITH REGARD TO THE VARIATIONS IN THE THERAPEUTIC POTENCY OF SERUM.

By Captain J. A. GLOVER, O.B.E.
Royal Army Medical Corps.
Officer in Charge, London District Cerebrospinal Fever Laboratory.

During the four war years 1915-1918, 243 cases of cerebrospinal fever occurred among the troops in the London Command. These cases have shown the most remarkable variations in their mortality rates at different periods, and they form an instructive study when viewed as a whole.

The large chart on p. 500 shows the four war years superimposed for comparison, and gives, as far as is known, in each case the type of the infecting coccus, and the death or recovery of the patient.

It is agreed that the chief factors determining the success of serum treatment are:—

(1) Early injection, which, of course, involves early diagnosis.

(2) Regular administration of a sufficient dosage, i.e., thirty cubic centimetres intrathecally at least every twenty-four hours for four days.

(3) Skilled treatment and nursing.

(4) A therapeutically potent serum.

As regards all the first three factors, the conditions in the London Command were practically identical throughout 1916, 1917 and 1918, though the arrangements (transport, special wards and special laboratory) up to about November, 1915, were not quite so complete as they were after this date.

The clinical indices of the therapeutic potency of a serum include a low death rate, speedy recoveries, absence of relapse and freedom from sequelæ, and experience shows that these indices are closely correlated.

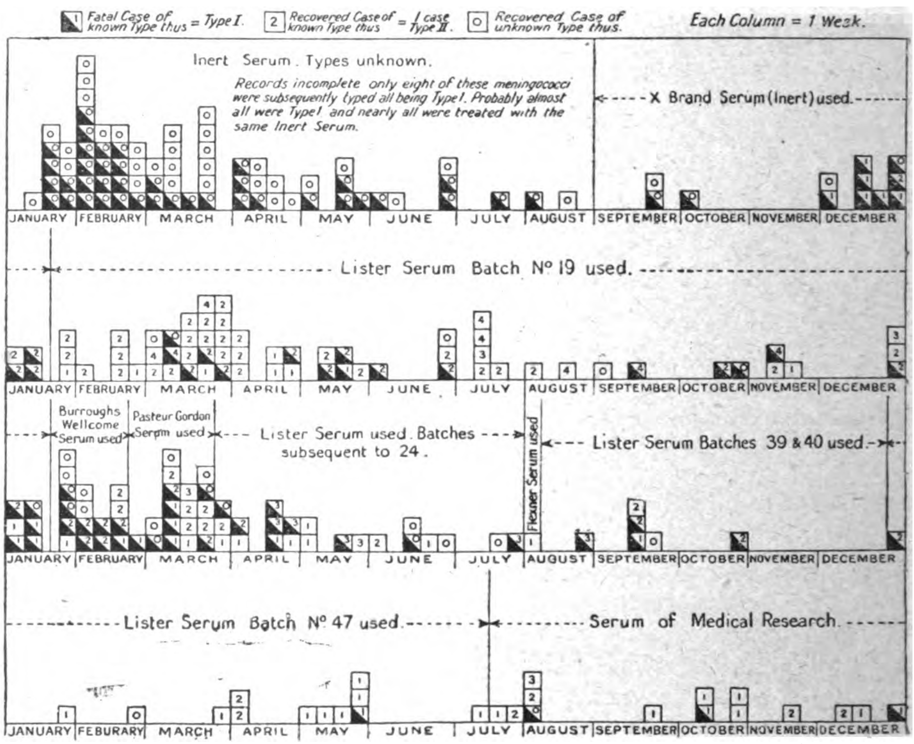
A serum the use of which gives a low death rate shows, as a rule, all the other advantages, and the percentage mortality being easily expressed and accurately recorded, therefore forms a convenient index of the potency or efficiency of a serum.

What then were the meanings of the strange variations in mortality shown by comparing the mortality rate of each year?

London Command Cases.
(There was only one case in 1914 and the patient recovered.)

	Number of cases	Deaths	Percentage mortality of cases
1915	83	49	59
1916	65	18	27
1917	69	36	52
1918	26	4	15
Total ..	243	107	44

CHART SHOWING INCIDENCE, TYPE AND MORTALITY OF CASES IN THE LONDON DISTRICT.



SUMMARY OF THE LARGE CHART.

1915. *Inert Serum.*

Type I.	Number of cases	6.	Fatal cases	6.	Percentage mortality	=	100
Type II.	,, ,,	1.	,,	1.	,, ,,		100
Unknown Type	,, ,,	76.	,,	42.	,, ,,		55
Total	,, ,,	83.	,,	49.	,, ,,		**59**

1916. *Lister No.* 19 *Batch* (begins 3rd week January).

Type I.	Number of cases	8.	Fatal cases	1.	Percentage mortality	=	12
Type II.	,, ,,	42.	,,	13.	,, ,,		31
Type III.	,, ,,	2.	,,	0.	,, ,,		—
Type IV.	,, ,,	8.	,,	3.	,, ,,		38
Unknown Type	,, ,,	5.	,,	2.	,, ,,		40
Total	,, ,,	65.	,,	18.	,, ,,		**27**

1917. *Various Serum.*

Type I.	Number of cases	20.	Fatal cases	10.	Percentage mortality	=	50
Type II.	,, ,,	23.	,,	13.	,, ,,		56
Type III.	,, ,,	8.	,,	6.	,, ,,		75
Unknown Type	,, ,,	18.	,,	7.	,, ,,		39
Total	,, ,,	69.	,,	36.	,, ,,		**52**

1918. *Lister* 47 *and M.R.C. Serum.*

Type I.	Number of cases	17.	Fatal cases	3.	Percentage mortality	=	18
Type II.	,, ,,	6.	,,	0.	,, ,,		—
Type III.	,, ,,	1.	,,	0.	,, ,,		—
Unknown Type	,, ,,	2.	,,	1.	,, ,,		50
Total	,, ,,	26.	,,	4.	,, ,,		**15**

Contrast these widely differing case mortality rates in the London Command, with those in the Military cases in the United Kingdom generally, and with the singularly constant civilian case mortality rate for all England (Rolleston and R. J. Reece).

PERCENTAGE OF FATAL CASES.

Year	London Command	Military cases, United Kingdom	Civilian cases, all England
1914	(Only one case, which recovered)	60 per cent (only from Sept. 19)	68·7 per cent
1915	59 per cent	49 per cent	64·9 ,,
1916	27 ,,	44·5 ,,	65·6 ,,
1917	52 ,,	44·3 ,,	65·4 ,,
1918	15 ,,	Not yet	available

VARIATIONS IN MORTALITY RATE NOT DUE TO VARIATIONS IN PREVALENT TYPE.

There was a great variation in the predominant type of meningococcus in each year.

In **1915** most of the cases in London were probably due to Type I (although the records are not so complete for this year as for subsequent years); in **1916**, Type II cases are by far the most numerous, more than five times as numerous as Type I cases; eight Type IV cases occurred in 1916, no other Type IV cases have occurred either before or since in the London Garrison; in **1917**, there was an almost equal mixture of Type I and Type II cases, no Type IV cases occurred, but eight Type III cases appear on the chart. In **1918**, Type I cases are again the predominant factor, being three times as numerous as the Type II cases.

This annual type variation will not account however for the variation in the mortality (although Type I has sometimes been regarded as the most dangerous strain), for the best years as regards mortality are 1916, a predominantly Type II year, and 1918, a predominantly Type I year.

VARIATIONS IN VIRULENCE.

Variations in the severity of the cases, due to variations in virulence of the infecting strain, are, of course, very difficult to distinguish when modified by the variations introduced by differing potency of serum.

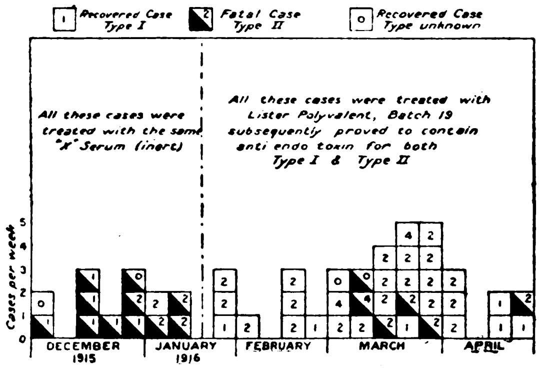
It will be seen, however, that the variations in the mortality rate take place with dramatic suddenness in the mid-career of an outbreak, that is irrespective of any probable change in the virulence of the infecting strain.

Examine, for example, the five months section of the large chart shown in the small chart on next page.

We have already noted that certain improvements in the routine hospital arrangements, etc., were made in November, 1915, but the chart shows that up to the end of the second week in January practically all

patients (whether of I, II, or unknown type), were dying; then comes an interval, a week without cases; and then for six weeks twelve cases occur without a death.

WEEKLY INCIDENCE AND MORTALITY FOR FIVE CONSECUTIVE MONTHS, MILITARY CASES ONLY, LONDON COMMAND, CONTRASTING THE EFFECT OF POTENT AND INERT SERA.



CASES IN THE FIVE MONTHS COMMENCING DECEMBER 1, 1915, AND ENDING APRIL 30, 1916.

Type of infecting meningococcus	Cases treated with a brand of therapeutically inert serum: Number of cases	Number of deaths	Percentage mortality	Cases treated with Lister serum. Polyvalent Batch 19 subsequently proved to contain anti-endotoxin for both Type I and Type II: Number of cases	Number of deaths	Percentage mortality
Type I	6	6	100	6	0	0
Type II	5	4	80	24	3	12·5
Type IV	0	0	0	3	1	33
Unknown Type ..	2	1	50	0	0	0
Totals ..	13	11	84	33	4	12

This dramatic change from almost certain death to almost certain redemption occurs in the middle of an outbreak, and corresponds exactly to the first use of a new brand of serum.

It is equally well shown in the chart and in the table.

In the latter it will be seen that for all types together the mortality rate of the Lister serum in these winter months is just one-seventh of that with the inert serum—twelve per cent instead of eighty-four per cent.

Had the use of the inert serum been continued and the mortality rate been maintained, of the 33 cases actually treated by Lister serum, it would appear probable that 27 would have died, instead of the 4 who actually died, as all the other factors were as constant as it was possible for them to be.

This emphasizes the tremendous importance of the question, the difference of the life or death of twenty-four patients in thirty-three cases.

Moreover, the serum was really polyvalent, it saved cases of Type II almost as uniformly as cases of Type I.

The batches of Lister serum from 17 to 24 were all of high therapeutic value; I am informed by Dr. MacConkey that batch 17 was the first in the preparation of which were used many fresh strains of meningococci from the 1915 epidemic, collected from many sources, but largely from Lieutenant-Colonel Gordon at the Central Cerebrospinal Laboratory, and from Dr. J. A. Arkwright at the Lister Institute, as contrasted with the batches prior to 17, which had been prepared with strains from outbreaks prior to the war.

Throughout 1916 the Lister serum continued apparently highly efficient, but it weakened towards the end of the year, and batches 19 to 24 having been used up, the subsequent batches did not give at all the same results.

So disappointing were the results in January, 1917, that, in the third week of this month (just one year after its dramatic initial success), a change was made in the London Command from Lister serum to serum by Burroughs Wellcome.

This Burroughs Wellcome serum was used in sixteen cases. Nine patients died, a mortality of 56 per cent.

Of eight known Type II cases six died (75 per cent).

A serum made by the Pasteur Institute with strains of meningococcus, supplied by Lieutenant-Colonel Gordon from the English epidemic, was then tried, eighteen patients being treated with this Pasteur-Gordon serum in the London Command, with eight deaths (mortality 44 per cent).

This appeared more promising than the previous results with regard to known Type II cases (2 deaths in 7 cases), but the Type I cases were very disappointing (4 deaths in 5 cases). Later batches of Lister serum were now used with varying success.

During the latter part of 1917 Lieutenant-Colonel Gordon was working upon the question of the anti-endotoxic value of serum (*vide British Medical Journal*, January 26, 1918, and January 28, 1919), and in December, 1917, he telephoned me that he had found a batch of Lister serum, No. 47 (hitherto untried clinically), which showed good anti-endotoxic powers, especially for Type I.

For the next six months this serum was used with great success in the Command, only 2 deaths occurring in 13 cases, and of 9 Type I cases only 1 died.

Batch 47 Lister becoming exhausted, the serum made by the Medical Research Committee's Field Laboratory at Cambridge, by Dr. Griffith, from strains supplied by Lieutenant-Colonel Gordon, was used with excellent results; the reader is referred to the larger number of cases reported by Major G. T. M. Hine (Medical Research Committee, White Paper, January 28, 1919).

Judging by the results obtained in the London district (not only with London Command cases) the Medical Research Committee serum

approaches perfection for Type I cases, but for Type II is much less satisfactory: a clinical verification of what might be expected from the complexity of the group and from the anti-endotoxic value of the serum as found *in vitro* by Lieutenant-Colonel Gordon.

Reviewing the five years' cases of the London Command, it would appear that the results are a striking clinical confirmation of the estimates of therapeutic potency formed by laboratory tests of the anti-endotoxic capacity of the serum, as shown by Gordon's modification of Besredka's method.

In the case of the Lister Batch 19 serum, which proved so successful in 1916, the test was retrospective, and we may quote Lieutenant-Colonel Gordon's words with regard to it:—

"It . . . was to be distinguished from sera of inferior clinical value neither by its agglutination titre nor by its opsonin content, nor apparently by its power to protect against the living coccus, but solely by the fact that 0·5 cubic centimetre of this serum possessed the power of neutralizing one M.L.D. of the endotoxin of each of the two commoner types of the meningococcus."

With regard to the equally successful Lister Batch 47 serum, the test was prophetic.

Colonel Gordon selected this batch untried from a number of others, because it possessed this degree of anti-endotoxic capacity and telephoned the result to me. The clinical trial was, as we have seen, a striking confirmation of the accuracy of the selection.

Moreover, the results with the Medical Research serum in the laboratory (Gordon, Special Report to Medical Research Committee, January 28, 1919), which indicate that this serum contains less anti-endotoxin for Type II meningococcus than for Type I are, I think, confirmed not only by the few cases treated by it, which appear on this London Command and chart, but by others which I have treated elsewhere, and again by the information received from other observers.

Cerebrospinal fever, as a military disease, has somewhat lost its importance, since overcrowding ceased with demobilization, but a considerable increase of civilian cases, if not a regular outbreak, might easily occur next winter, as the number of chronic carriers demobilized must be considerable, and the importance of having a satisfactory laboratory test of the therapeutic potency of serum is of an obvious and vital importance.

My best thanks are due to my assistants, Serjt. C. S. Barrett and Cpl. R. H. Piejus, for their able help throughout.

THE MEDICAL SERVICE OF A TERRITORIAL DIVISION.

By Colonel E. C. FREEMAN, C.M.G.
Territorial Force Reserve.

Now that the Territorial Force is to be re-established on a broader basis, some experiences derived from seven years' service in it as D.A.D.M.S. and A.D M.S. may be of interest.

The old Territorial Force was organized in Divisions, each with three field ambulances and a regimental medical officer to every battalion or other unit. Attached to the Division for administration in peace were the cadre of a general hospital and the field ambulance of a mounted brigade. Over this medical organization was an A.D.M.S. (a Territorial officer), who was assisted by a retired R.A.M.C. officer as D.A.D.M.S., and later a D.A.D.M.S. Sanitation was added who was a Territorial.

At the start both officers and men were drawn from the old Volunteer Force, the remains of the Brigade bearer companies forming the nuclei of the field ambulances, so a great deal of teaching was necessary before the modern divisional organization was understood. At the same time the great bugbear, that the whole scheme was a trap to get men to serve in India, had to be laid to rest, hence the emphasis laid on the obligation being for home service only. After this recruits came in freely. The R.A.M.C.T. was always a popular branch of the Territorial Force, not only on account of the higher rates of pay, but because men found the work interesting, and learned much which was useful in civil life. The field ambulances having their own transport drivers was another great attraction. Efforts were directed to recruit men who were intelligent and educated as well as physically fit, and also tradesmen such as cooks, butchers, carpenters, etc., who would be useful on service. It was very much more difficult to secure officers of the right stamp. Successful men could not leave their practices, and unsuccessful men we did not want. Patriotism and military ardour were the only inducements to join; the man gained nothing socially, and sometimes lost the confidence of old-fashioned patients by taking service in the R.A.M.C.T. This is a matter which will require the most anxious consideration by those responsible for the new Territorial Force, and unless much greater inducements are offered there will be a great shortage of medical officers. The regimental medical officer was generally a friend of, and recruited by, the officer commanding the regiment. If he was a strong personality and at all tactful he became an authority with officers and men, and liked his position immensely; but this was not always the case, and then urgent requests came in for transfer to a field ambulance. It is certainly most desirable that every medical man on joining should be attached for his first year to a field ambulance, so that he can

go to his unit afterwards with a knowledge of his duties and of military routine.

The beginnings of the field ambulances, with improvised transport, were very ragged, and at the first annual camp their appearance was quaint. Later, complete equipment and wagons for one section of a field ambulance (quite enough for instructional purposes) was issued to each of them, and they became very smart and effective, and the personnel got to know their work thoroughly.

The organization for instruction was good, and will, it is hoped, be repeated. Besides the annual camp, lectures and drills went on all the year round. Each field ambulance had a Regular N.C.O. as company serjeant-major, and there was in addition a school of instruction under an adjutant (a serving R.A.M.C. officer), with two R.A.M.C. and one A.S.C. serjeant instructors. This school was attached to the medical headquarters of the Division, but experience soon showed that neither officers nor men could spare time to come to headquarters, so it went perpetually on tour, visiting each field ambulance in turn, and also centres convenient for the attendance of regimental officers. The results, owing to the enthusiasm of the adjutants, were excellent. All medical officers were able to pass the necessary examinations in good time, and each field ambulance got a good dusting up before annual camp.

About this annual camp something must be said. The Division was only once able in seven years to go into camp as a whole; in other years it went by brigades or smaller units. There was at the time acute controversy as to the best method of training medical units in camp. One school considered they were best trained segregated apart from other troops, "with nothing to disturb their attention." Others, and the writer among them, thought that training a field ambulance without actual treatment of real sick cases was like training an artillery battery without range practice, also that it was important to promote good feeling between the medical and fighting units, and to show the latter (who were extraordinarily ignorant) the efficiency of the medical arrangements they would have to depend on in war. Hence we always sent the field ambulance into camp with the brigades, and the officer commanding field ambulance acted as senior medical officer of brigade, and supervised all medical and sanitary matters. The results were good, and the brigadiers also became interested in the field ambulances and their work. These annual camps were a great factor in recruiting. Camps near home were always most unpopular, the men preferring to go right away, and if possible to the seaside. The finding of suitable camp sites with training ground available was always a difficulty.

We now come to mobilization, which was carefully prepared for from the beginning. War stations, camping grounds, time tables were arranged in full detail and communicated to all concerned. These schemes were elaborated year by year to great perfection, but *horribile dictu!* in January 1914 the War Office suddenly changed the plan of working, the

whole scheme had to be scrapped and a new one suited to the altered conditions hurriedly made out. Notwithstanding this contretemps, on August 4, 1914, mobilization took place without a hitch, all equipments, stores and personnel, horses and vehicles turning up according to the time-table, and the field ambulances were able to march at an early state of mobilization. Owing however to their proceeding by march route there were two or three awkward days in the concentration centre where infantry and artillery were pouring in as fast as trains could bring them, and the Medical Service was represented by the A.D.M.S. and his two D.A.Ds.M.S. and the headquarter of the field ambulance. However we were able to invoke the aid of the Red Cross. In peace time much trouble had been taken throughout the divisional area to help and co-operate with the Voluntary Aid Detachments; inspections, field days and schemes of work with the field ambulances had been in vogue and the result was that the division received every assistance from the Red Cross in East Anglia, although public interest was naturally concentrated on "overseas wounded."

After much trekking and bivouacking the Division presently found itself doing home defence in East Anglia, for which its local knowledge specially fitted it, and stationed pretty much as in the original mobilization scheme which had been scrapped. The medical interest of this period lay in anti-typhoid inoculations and vaccinations and several slight outbreaks of infectious disease, including a few meningitis cases, which were quickly stamped out with the ready co-operation of the county and district medical officers of health and the Local Government Board. Much time was occupied in asking the Division to volunteer for overseas, but the reply was almost unanimous and only one medical officer who was fit failed to respond.

In the following April the Division moved south to get ready to go overseas, and second line units were formed in which those who were to remain at home received rapid promotion. To increase efficiency three or four of the best battalions and one field ambulance were taken away for France and replaced by units from elsewhere. Finally a casualty clearing station and a sanitary section were raised and men were told off from the field ambulances to the battalions as "water duty" men—a most unpopular service with all concerned. It may be added that the casualty clearing station was torpedoed and lost in the Mediterranean and the sanitary section joined later at Gallipoli. The cherished transport, which had been worked up to a high state of perfection under special transport officers, had first to be handed over to the Army Service Corps and later left behind with all the artillery and vehicles when the Division sailed in July, landing at Suvla in August.

This disembarkation on an enemy shore exhibited the usual faults—medical officers separated from their personnel and field ambulances from their equipment. It seems impossible to make the layman understand that a medical unit without its equipment is as useless as an artillery battery

without its guns. The result in this case was that only one field ambulance was disembarked fit for duty and, as the Division almost immediately went into action, one had to be borrowed from another Division through the D.D.M S. Army Corps. Successive ships however brought in the missing men and stores and we settled down upon the Gallipoli peninsula. Here, however, conditions were so abnormal that not much can be learnt for future use. The Turks did not fire on hospitals unless they covered a battery or point of military importance: but in the confined area it was difficult to find any spot which was not in the line of something, and one field ambulance had to be placed boldly on the flat seashore—it was never shelled but suffered a good deal from "strays and overs;" another which was under cover of the hillside got fairly shelled one day, but that was probably an accident. The advanced dressing stations could only be evacuated after dusk, and for this purpose wheeled stretchers were most useful. As we had no transport application was made for these very shortly after our arrival; they were not available for some time but were a great boon when received. They consisted of a detachable stretcher and a pair of bicycle wheels with a crosspiece, and should be supplied in quantity under similar circumstances in future.

The proximity of the trenches to the clearing hospitals and the beach made it very difficult to properly control the evacuation of the sick and wounded. The destination they reached depended entirely on the hospital ship which happened to be at hand. Some reached England, others Alexandria or Malta, some got only to Mudros, but all were lost to the Division. Application was made for a convalescent camp to be formed at Imbros, detailing half of one of our field ambulances for the purpose, but the proposition was negatived. Could this have been done or a hospital ship kept permanently in the offing for the same purpose, there would have been a noticeable reduction in the numbers evacuated. It stands to reason that even mild dysentery cases will not improve when they lie exposed to chance bullets and cannot get proper fresh food.

As the Peninsula was unfitted for women, all nursing had to be done by the orderlies, so previous training in nursing duties proved very useful. Under the auspices of the D.D.M.S. Australian Corps a Medical Society was formed and interesting papers at the meetings were enlivened by the bursting of Turkish shells. These meetings were most useful as men got to know their Australian confrères and could compare notes as to the treatment of the ever present dysentery. Great attention was directed to sanitation, but the close proximity of the enemy made all efforts very difficult and a disinfector for clothing from which much was hoped was shelled to pieces the first time it was used. The scanty water supply which came in barges from Alexandria was chlorinated, and sometimes superchlorinated—which possibly accounts for some cases of trench nephritis. No cooking was allowed in the trenches as it drew fire, so no hot soup or coffee could be made to replace the rum ration. I got this issued as often as possible

as everybody was exhausted and doing double turns of work, and no indiscipline or ill-effects resulted. Discipline was very good, though the men were tried very highly, especially by heat and thirst, to which they were quite unaccustomed, and all the regular N.C.O.'s had been taken away. In peace time T.F. discipline was moderate only, but on leaving England they came up to full standard at once. The Division, which landed over 12,000 strong, had 2,000 nominally fit men when it was evacuated in December. It rested awhile at Alexandria and refitted at Mena, near Cairo, where it was joined by the artillery, and transport was also organized; fortunately the field ambulances had a good many trained drivers serving in the ranks as stretcher-bearers. Thus reorganized and with the depleted ranks refilled, it spent a year in the Canal zone, sending many flying columns into the desert, and afterwards did good service in the campaign in Palestine. Most of the R.A.M.C.T.F. officers and men are now safely home again, and it is to the younger ones among them that we must look to carry the tradition of the old Division into the new organization which is shortly to arise.

Clinical and other Notes.

AN OUTBREAK OF FOOD POISONING IN A GENERAL HOSPITAL.

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The following is an account of a sudden and very violent outbreak of food poisoning which took place in No. 31 General Hospital at Port Said on January 19 and 20, 1917.

The epidemic affected a very large proportion of all the patients in hospital, and a few of the orderlies employed in the wards and in the dining hall. In all 473 men developed symptoms of more or less severity and there were three deaths attributable to the poisoning.

No. 31 General Hospital was situated in the magnificent new workshops of the Suez Canal Company on the east side of the canal. The hospital was thus separated from the town of Port Said by the width of the harbour. The site was healthy and the surroundings sanitary. At the time of the epidemic the weather was cold and flies were negligible.

The first case occurred at 8 p.m. on Friday, January 19 and the last one recorded, on Monday, January 22 at 10 a.m

The greater number of the patients fell ill between the hours of 12 midnight on January 19, and the same hour on January 20.

For purposes of description the symptoms of this outbreak can be best considered under three headings, viz., as they appeared in :—

(1) Mild cases.
(2) Severe cases.
(3) Fatal cases.

The great bulk of the cases belong to the second group—the mild cases were limited in number and appeared, as would be expected, towards the end of the outbreak.

Duration.—The duration of the disease was twelve hours in mild cases to four days in the most severe. The average duration was forty-eight to seventy-two hours.

Symptoms.—The onset of this disease was heralded in all severe cases, which occurred during waking hours, by some degree of shivering, which in many instances amounted to an actual rigor. This was closely followed by headache (sometimes occipital, sometimes frontal), pains all over the body, and in severe cases by abdominal pains which varied from slight colic to the most severe

griping. Diarrhœa and vomiting accompanied this pain in most instances, but in a certain number vomiting was the predominant symptom, and in a few cases the bowels had to be opened with an enema. In another group the diarrhœa was not evident in the first twenty-four to thirty-six hours, but occurred with the crisis or lysis as the case might be. The vomit in all instances was greenish, sometimes tinged with blue, sometimes yellow, and in the later stages of severe cases consisted mostly of mucus with streaks of blood. The stools were yellow and watery and presented no features of interest. In two cases some blood appeared in the stools, but these were possibly old cases of dysentery. Within an hour or so of the onset of the symptoms, the face was flushed, the patient drowsy, the tongue furred and the temperature raised. The latter generally reached its maximum within the first twelve hours. This maximum temperature varied in severe cases from 103° to 106° F., and was maintained at a correspondingly high level for twenty-four to thirty-six hours.

In the greater number of cases the temperature then fell rapidly, reaching normal within forty-eight to seventy-two hours from the beginning of the disease. In a few debilitated subjects crisis was associated with a collapse temperature of 95° to 96° F.

A number of charts show slight rises of temperature after this period for the following twenty-four to forty-eight hours.

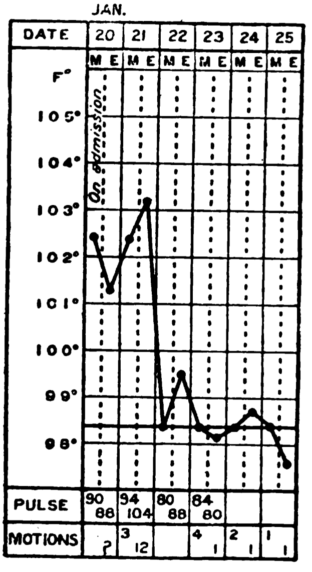
Within a few hours of the onset the pulse rate was invariably greatly increased and often in excess of the normal pulse temperature ratio. Thus in many severe cases the rate recorded from the first forty-eight hours of the disease actually reached 140 to 160 per minute and the average pulse rate was 120 to 130 per minute.

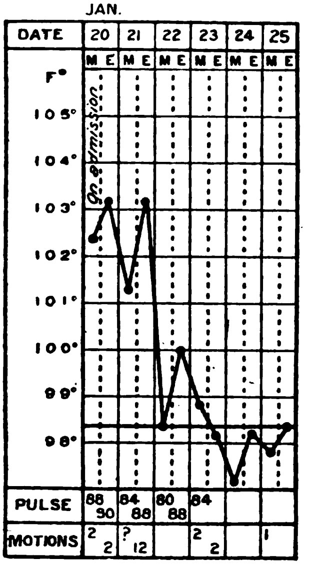
In the later stages of the most severe, and in all the fatal cases, constant vomiting, restlessness, insomnia, hoarseness of the voice, lividity of the cheeks and mucous membranes, coldness of the extremities, a dry brown tongue, sunken half-closed eyes, were prominent features. In a few of the worst cases actual incontinence of fæces and urine occurred. A moderate degree of albumin was present in the urine tested. In the fatal cases, great restlessness, with pain in the extremities, but no tetaniform spasm, laboured breathing, imperceptible pulse, and in one case suppression of urine for three days, followed by a brief period of coma, marked the end.

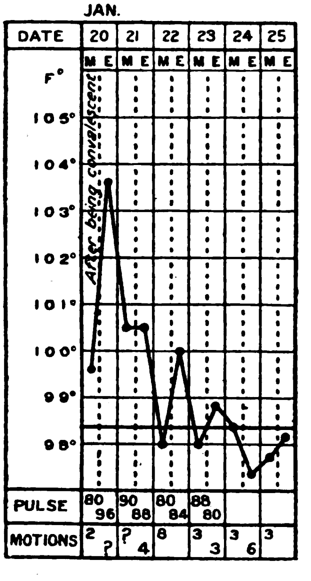
The mild cases which occurred towards the end of the outbreak presented merely symptoms of headache and a transient diarrhœa. The treatment resorted to in the absence of any known poisoning agent was symptomatic. Lavage of the stomach, castor oil and opium with repeated saline infusions aud the administration of various cardiac stimulants and gastric sedatives were all tried with varying success.

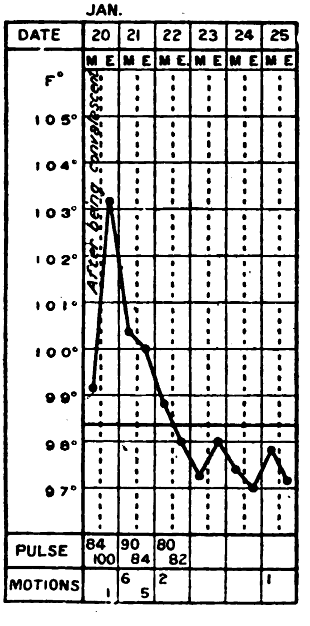
Post-mortem Examination.—Post-mortem examinations were made on two of the fatal cases but revealed very little change to the naked eye. In both cases, irritation of the pyloric end of the stomach and first three or four inches of the duodenum was well marked. In the second of these cases there was an associated, diffuse, acute inflammation of the lower eighteen inches of the ileum and the whole of the large intestine, but as these changes occurred in a patient convalescent from dysentery, it seems probable that they might have been caused by a recurrence of an original bacillary dysentery. In both instances the right side of the heart was enlarged and distended with blood and the left ventricle

firmly contracted. Specimens of bile, blood and intestinal contents were taken in each case for laboratory examinations and the contents of one stomach were forwarded for analysis.







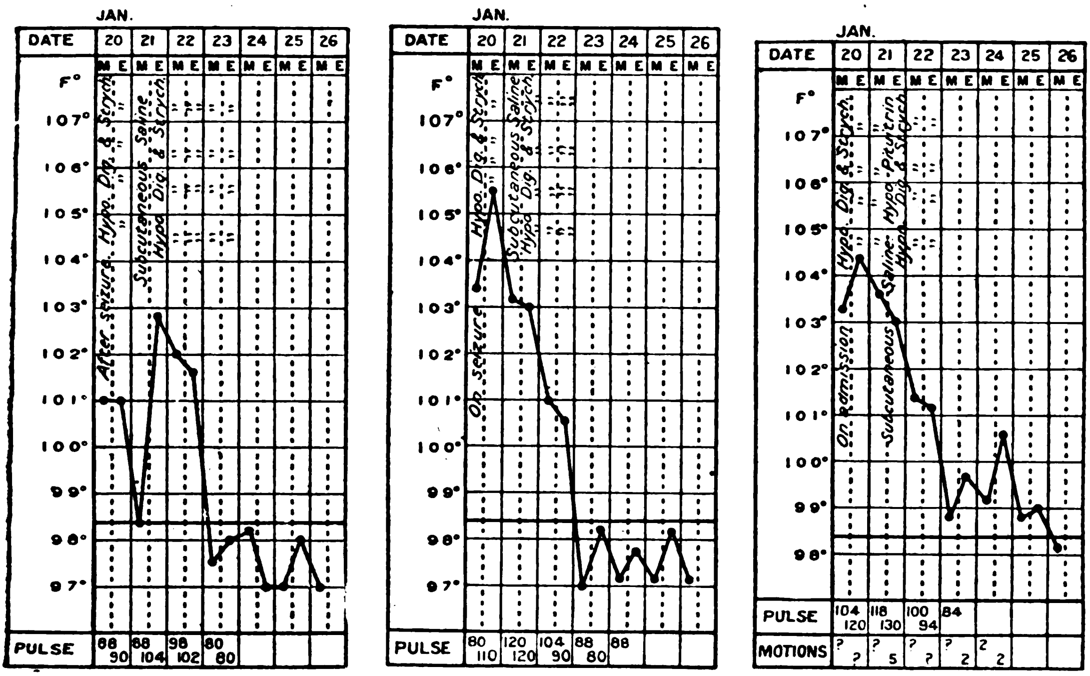


Investigation into the Causes of the Epidemic.—The outbreak affected 473 men, of which 441 were patients and 32 were orderlies employed in the wards or patients' dining hall.

Not a single case occurred :—
(1) Among the officer patients in hospital.
(2) Among the orderlies not employed in wards or dining hall.
(3) Among the medical officers.
(4) Among the nursing sisters.

Each of these groups of persons was served by a separate kitchen, and received no food from the hospital kitchen.

The incidence of the outbreak fell chiefly on patients on "ordinary diet"—328 (85·6 per cent) of such patients as against 114 (64·3 per cent) of those on other diets.



The chief items in the dietary on January 19, upon which suspicion might fall, were :—

Beef stew, tapioca pudding, butter, tea, cocoa, marmalade. The last mentioned may be neglected as it was taken by comparatively few patients.

Other items as bread, sugar, salt, bacon, etc., may be neglected on the grounds that groups 1, 2, 3, 4 mentioned above, all had the same articles.

It remains, therefore, to investigate the beef stew, tapioca pudding, butter, tea and cocoa, all cooked in the hospital kitchen and served up in the wards and dining hall.

Each of these five articles of diet were consumed by the majority of the patients and there seems no possibility of doubting that one or more of them contained the poison which caused the disease in so large a proportion of those who consumed them. The difficulty of differentiating between them and definitely inculpating one particular article is considerable, as so many of the patients partook

of all five articles. The only way to approach the subject seems to be to take each article of diet separately and to estimate the percentage of persons who partook of it and were taken ill, and to compare the percentages arrived at for each article; at the same time to compare in the case of each article the percentage of persons affected who did not partake of it.

The following is a comparison of these percentages:—

Article of diet	Percentage of persons eating it who were affected	Percentage of persons affected who did not eat it
Beef stew	85·6	64·3
Tapioca pudding	87·7	42·4
Cocoa	83·9	73·8
Butter	83·1	50·0
Tea	86·1	36·0

As a result of this comparison two articles immediately fall under suspicion: Tapioca pudding and tea. Each show a percentage well above the average of 85·2, while at the same time the percentage of persons taken ill who did not partake of these articles is markedly low.

Suspicion having fallen on these two items a very close investigation was made into each case, to ascertain whether the patient had partaken of the pudding, or tea or both, and the following facts were elicited.

Tapioca Pudding.—The total number of patients who ate this article was 471, of whom 413 were poisoned and 58 escaped; 66 patients did not eat tapioca and of these 28 were poisoned.

If, therefore, the cause lay in the tapioca pudding there must have been a secondary cause. Of the twenty-eight persons who had no tapioca pudding and yet were poisoned: 21 had custard, 7 had none; 23 had cocoa, 5 had none; 28 had tea, 28 had butter. (Butter may be eliminated as it was issued in one-pound tins, and it is not probable that so many separate tins were infected on the same day by the same organism and none on preceding or succeeding days.)

Tea.—It is difficult to get an accurate return of patients who drank tea made in the hospital kitchen, as in some cases tea was made in the wards by the sisters. But on careful inquiry only five patients could be discovered who were poisoned and who definitely did not have tea from the kitchen. Of these 5: 1 had custard and 4 had none; 5 had tapioca pudding, 3 had cocoa and 2 had none.

The positive results of the statistical examination into the outbreak among the patients are therefore:—

Of the 441 patients poisoned, 413 partook of the tapicoa pudding and 28 did not. These 28 all had tea; no other article of diet was common to them all.

Again, of the 441 patients poisoned, all but 5 had tea from the kitchen; of these 5 all had tapioca pudding. No other article of diet was common to them all.

It would appear, therefore, that suspicion must rest on the tapioca pudding eaten at dinner on January 19, and also on the tea drunk at tea-time on the same day.

These results can be checked by a similar inquiry into the cause of poisoning among the orderlies.

As previously mentioned all the orderlies affected were employed in the wards

or in the dining hall. Their diet, except for what they picked up in the wards and dining hall, was identical with that of the rest of the company. An inquiry into what they had taken in the wards and dining hall elicited the following facts: Of 31 orderlies poisoned: 13 had tea, 18 had none; 7 had cocoa, 24 had none; 3 had custard, 28 had none: 24 had tapioca, 7 had none.

Tapioca pudding again heads the list and tea is second. Of 7 orderlies who state they had no pudding: 2 had tea and cocoa; 3 had tea alone; 1 had cocoa alone: 1 had nothing except coffee.

(This latter man had vomiting and no diarrhœa. It is quite possible that he was not one of the cases of poisoning at all. His symptoms may have been due to anti-plague inoculation, which he had recently received.)

Out of 30 orderlies definitely suffering from the disease we find that: 24 ate tapioca pudding, and of the remaining 6 all but 1 had tea. This entirely confirms the finding in the case of the patients, and it may therefore be reasonably assumed that *the tapioca pudding and the tea contained the poison.*

The ingredients in common to these two items were sugar and unsweetened tinned milk.

Sugar may be put aside, as it entered into so many articles of food not only in the hospital, but in the company's dietary, the officers' and the nurses' and also the officers' ward.

A similar argument may be used, of course, against the milk, but in this case it is possible to suppose that there was a certain limited number of tins infected with a poisonous organism.

The organism described later, which was found in the fæces and vomit of patients and in the heart's blood, intestines, etc., of those who died of the illness, grows freely in the particular brand of milk used, at room temperature, without changing the appearance or smell of the milk. One or more tins of the milk, therefore, infected with the organism might easily have passed undetected and been used in the pudding and tea, and it is a noteworthy fact that the tapioca pudding under suspicion was a particularly good one and many patients in the dining hall had two helpings and signified their approval of it.

It might perhaps be considered that tea alone was the vehicle of the poisonous agent, but this theory is practically disproved by the case of the orderlies. There were about 300 Royal Army Medical Corps personnel working in the hospital and of these only thirty were definitely affected. All these thirty men admitted having illicitly taken some foods in the wards or patients' dining hall, but only thirteen admitted having drunk tea. And their statement may be accepted, since many of them were off duty at tea time and some were actually on pass. The orderlies, in fact, supply a very valuable index to the whole affair, as there is no doubt that most of them took no food in the wards except the remains of the pudding left in the bottom of the cans or by patients in their bowls.

The milk having thus fallen under strong suspicion, the questions arise how and at what stage of the preparation of the food could the infective agents have made their way into the milk.

The tapioca pudding was made in the following way:—

On January 19 there were 544 tins of milk issued to the hospital kitchen. The tins were opened in the steward's store, and sent over to the kitchen, where the milk for the pudding was poured into a large cauldron and brought to the boil, In the meantime the tapioca was being boiled in water in two Soyer's stoves.

The boiling milk was added to the boiling water and tapioca. It was allowed to boil for about three minutes more and was then taken off the fire and poured hot into the cans which had been brought from each ward for it. Still hot, it was taken to the wards and served out direct from the cans into the patients' bowls by the sisters.

It is difficult to see how any organism could survive the heating necessary for the proper cooking of a milk pudding, and it is still more difficult to imagine how the pudding could have become infected after cooking. It is not to be supposed that the same infective organism could have been present in each of some dozen cans from different wards.

Similarly with the tea. The milk was opened in the steward's store, taken to the kitchen, added to the boiling water in the Soyer's stoves, boiled again, the infusion added and despatched hot to the wards in the cans sent from each ward.

The brand of milk used certainly was often far from sterile. Many tins were blown and contained coagulated milk. These were easily picked out and rejected. If, however, an organism was present which gave no gas and did not clot milk, it would have been impossible to detect it—and the milk would have been used.

Unfortunately none of the milk from the tins opened on the 19th was available for examination, but milk from the first case opened on January 20 was examined. Out of the forty-eight tins in this case, ten were bad, the milk being coagulated. These were submitted to the pathologist, and his report shows the presence of coliform organisms and streptococci. This is evidence that the heat employed in the sterilization of the tins was insufficient to kill non-sporing bacilli, and it is therefore prima facie evidence that the organism which caused the epidemic could have survived in the tins of milk. Farther than this it is not possible to go.

It may be mentioned here that all the patients on milk diet escaped the infection and their immunity was due to the fact that the milk given to such patients was fresh cows' milk. The supply of fresh milk was, however, limited, and all milk used for other diets was unsweetened tinned milk.

The exact causation of this epidemic, therefore, remains obscure. The infective agent was evidently the bacillus found in the heart's blood and intestinal contents of the victims.

The vehicle by which it reached the persons attacked was probably milk contained in the tapioca pudding and tea. But how it got into these articles of food is a mystery and must always remain one. Much time and trouble was taken in searching for any possible clue and several sanitary officers interested themselves in the outbreak, but the truth eluded us all and we could find no solution of the problem.

One thing seems probable, and that is that the milk was in some way infected after the tins were opened. The same brand of milk was used in all hospitals and supplied to all troops in the Middle East throughout the war, and, as far as we know, this was the only outbreak of food poisoning attributed to it.

Pathologist's Report on Investigations connected with the Outbreak of Gastro-enteritis in No. 31 General Hospital.

(1) *Material Examined.*—Fæces: Specimens from eight cases were examined. Two gave negative results; from the other six a bacillus giving the characters described below was isolated. This organism is hereinafter called the *Bacillus x.*

TABLE I.

No.	Name and source	Gelatine liquefaction	Motility	Glucose	Lactose	Saccharose	Dextrin	Salicin	Glycerine	Dulcite	Mannite	Litmus milk	Agglutination limits. Sera		
													Para A	Para B	Gärtner
1	Dixon, fæces	—	++	A	O	O	..	..	..	O—A	A	A—Alk	Nil	1/4000 +++	1/200 Tr
2	Turner, fæces	—	++	A	O	O	..	..	..	O—A	A	A—Alk	Nil	1/4000 ++	1/200 +
3	Wheelock, fæces	—	++	A	O	O	..	..	..	O—A	A	A—Alk	Nil	1/800 + 1/1600 —	Nil
4	Gulbranson, vomit	—	++	A	O	O	..	..	..	O—A	A	A—Alk	Nil	1/8000 ++	1/200 +
5	Barker, fæces	—	++	A	O	O	A—Alk	O	O—Sl. A	O—A	A	A—Alk	Nil	1/8000 ++	1/200 Tr
6	Thiselton, fæces	—	++	A	O	O	..	..	..	O—A	A	A—Alk	1/200	1/8000 +++	1/200 Tr
7	Mardon, vomit	—	++	A	O	O	..	..	..	O—A	A	A—Alk	1/200 Tr	1/500 + 1/1000 —	1/800 ++ 1/1000 Tr
8	Elliot, p.m.	—	++	A	O	O	A—Alk	O	O—Sl. A	O—A	A	A—Alk	1/200 Tr	1/8000 +++	1/500 ++ 1/1000 Tr
9	Gulbranson, fæces	—	++	A	O	O	A—Alk	O	O—Sl. A	O—A	A	A—Alk	Nil	1/8000 +++	1/200 Tr
10	Gulbranson, p.m.	—	++	A	O	O	A—Alk	O	O—Sl. A	O—A	A	A—Alk	1/400 +	1/4000 ++	1/1000 ++ 1/2000 +
	Strain No. 8, 2½ years later	..	..	..	..	..	..	..	..	..	..	..	Nil	1/4000 +++	1/200 ++ 1/400 +

Tr = trace

Vomit: Two specimens examined yielded the same bacillus.

Blood cultures were made in four cases with negative results.

Material from two post-mortems was examined. The bacillus was isolated from both; in the first from the contents of the lower part of the ileum, in the second from the heart blood, bile, and bowel contents.

These examinations represent fourteen patients, viz.: 1—vomit, fæces, and post mortem; 5—fæces only; 1—vomit only; 1—post mortem only; 6 negative—4 blood cultures, 2 fæces.

(2) *Characters of the Bacillus x.*—A short, Gram-negative, highly motile bacillus; grows well in broth and on agar and gelatin; gelatin is not liquefied. Fermentation reactions: Glucose, acid twenty-four hours, no gas seven days. Lactose, no change seven days. Saccharose, no change seven days. Mannite, acid twenty-four hours, no gas seven days. Dulcite, no change twenty-four hours, acid forty-eight hours, no gas seven days. Dextrine, slightly acid twenty-four, alkaline by third day. Salicin, no change. Glycerine, no change till fourth day, then slightly acid. Litmus milk, acid twenty-four hours, alkaline from third day. Indol is not produced.

These tests have been repeated many times during the past two and a half years, and have remained constant; no gas has ever been produced in any carbohydrate medium.

(3) *Agglutination Reactions.*—None of the strains isolated were agglutinated by *Bacillus typhosus* serum at 1 : 200. Two strains were agglutinated by *B. paratyphosus* A serum at 1 : 200 and 1 : 400 respectively. All the strains were agglutinated by *B. paratyphosus* B serum (homologous titre 1 : 8,000) at 1 : 4000, and partially at 1 : 8000, except two, one of which did not go beyond 1 : 500, and the other 1 : 800. All strains but one were agglutinated slightly by Gaertner serum at 1 : 200, one at 1 : 800, and one at 1 : 2000.

The macroscopic technique was used, with an incubation of three hours at 37° C., the results being read after standing overnight on the bench.

The fermentation and agglutination reactions of several strains at the time of isolation are shown in Table I, together with the agglutination reactions shown by one strain in my possession two and a half years after isolation.

The organism was considered to be a member of the food-poisoning group. At first sight it would seem to be an atypical *B. paratyphosus* B, but further experiments proved this was not so.

(4) *Absorption Experiments.*—The following table shows the results of absorption experiments carried out with *B. paratyphosus* B serum.

TABLE II.

B. paratyphosus B serum	v. *B. paratyphosus* B	v. Bacillus X
Original titre	1/10000 +++	1/4000 +++ 1/8000 ++
After absorption with *B. paratyphosus* B	1/200 Tr 1/400 nil	1/200 nil
After absorption with Bacillus X ..	1/6000 +++ 1/8000 ++	1/200 nil

This clearly shows that the organism is not a *B. paratyphosus* B. The only pathogenic organism which answers to the cultural and agglutination characteristics of *B. paratyphosus* B, and yet can be differentiated by absorption tests, is *B. suipestifer vel Aertrycke.* Unfortunately I had no suipestifer serum and none could be obtained from the Public Health Department, Cairo. Since coming home I have, through the kindness of Dr. Arkwright, of the Lister Institute, obtained suipestifer serum A and B types. The bacillus is agglutinated to the full titre of suipestifer A (Mutton) serum, and only sligtly by suipestifer B (Newport) serum. It may therefore be taken as established that the organism isolated from many cases of this food-poisoning outbreak is an atypical *B. suipestifer* A.

TABLE III.

Serum	Organism	1/50	1/100	1/200	1/400	Last T.A.B. inoculations
Dixon, Bacillus isolated from fæces	His own X ..	+++	+++	++	+	August, 1916
	BX from P.M.	+++	+++	+	Tr	
	Stock para B	+++	+++	++	+	
Turner, Bacillus isolated from fæces	His own X ..	+++	++	+	—	August, 1916
	X from P.M.	++	++	+	—	
	Stock para B	+++	++	++	+	
Wheelock, Bacillus isolated from fæces	His own X ..	+++	+++	++	++	May, 1916
	X from P.M.	+++	++	+	Tr	
	Stock para B.	++	++	+	—	
Thiselton, Bacillus isolated from fæces	His own X ..	+++	+++	+++	+	July, 1916
	Stock para B	+++	+++	+++	++	
Kewley, Blood culture negative	X from P.M.	+++	+++	+	Tr	August, 1916
	Stock para B	+++	+++	++	+	
Holmes, Blood culture negative	X from P.M.	+++	+++	+	+	August, 1916
	Stock para B	+++	+++	++	Tr	
Edwards, Blood culture negative	X from P.M.	+++	+++	++	+	August, 1916
	Stock para B	+++	+++	+++	++	
Legg, fæces culture negative	X from P.M.	++	++	+	—	August, 1916
	Stock para B	+++	++	++	Tr	
Own serum	X from P.M.	—	—	—	—	February, 1916
Laboratory attendant	X from P.M.	—	—	—	—	August, 1916
	Stock para B	++	Tr	—	—	

Parallel agglutination tests were done against a laboratory strain of *B. paratyphosus* B on account of the high agglutination of the bacillus X with paratyphosus B serum. All the patients' sera agglutinated this stock strain in higher dilutions than can be accounted for by inoculations of T.A.B., the dates of which are given.

(5) *Pathogenicity for Animals.*—A cat was fed with milk containing one-half of an eighteen-hour agar slope culture of this bacillus. Beyond a transient diarrhœa some four hours later it showed no ill effects, and when killed two days later no post-mortem signs of enteritis were found. The bacillus was recovered from the cat's spleen, but not from its heart-blood.

A 250-gramme guinea-pig was given a subcutaneous injection of about one

twentieth of the same culture. It died in twenty-six hours, the bacillus being recovered from its heart-blood, bile, and spleen.

The organism—even killed by heat—proved very toxic to the rabbit. Two rabbits died in the process of immunization. A third rabbit was being immunized by smaller doses at longer intervals. It had survived three doses of 150, 300, and 1,000 millions, but its serum titre was only 1 : 160, when this work was broken off by my return to England.

(6) *Agglutinin Production in Patients' Sera.*—The sera of eight men affected by the outbreak were examined on the ninth day. From four of these the bacillus had been isolated; the other four had been examined with negative results. As controls two normal sera were also tested, my own and that of the laboratory attendant, neither of us having been infected. The results are shown in Table III.

(7) *Further Examinations.*—Bainbridge states that whereas an acute gastro-enteritis of paratyphosus B origin has on several occasions been traced to a human carrier, no case of a human carrier of *B. suipestifer* has been recorded.

The urines of eleven men employed as cooks in the hospital cookhouse were examined on three successive days. None of them yielded the bacillus X or any organism of the paratyphoid-Gaertner group. The sera of these eleven cooks and of four storemen employed in the food stores was examined for the presence of agglutinins against the bacillus X and my stock strain of *B. paratyphosus* B. The following was the result.

TABLE IV.

	Cooks											Storemen			
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4
Bacillus X	Nil	1/20	1/20	Nil	1/20	Nil	Nil	Tr 1/20	Nil	Tr 1/20	Nil	Tr 1/20	Nil	Nil	Nil
Para. B..	1/80	1/160	1/80	Nil	1/40	1/40	1/80	1/20	1/80	1/160	1/20	1/160	1/160	1/80	1/80

The tins of milk implicated in the outbreak having unfortunately been incinerated before the outbreak occurred it was not possible to make a bacteriological examination of the contents. Within the next few days after the outbreak, however, a number of tins of milk were sent to the laboratory for examination. More than one dozen samples were cultured aerobically, and six samples anaerobically. Coliform bacilli grew in two aerobic cultures, and streptococci in three anaerobic cultures. No organism of the paratyphoid-Gaertner group was found in any culture.

Vitality of the Organism.—To test the vitality of this organism under anaerobic conditions, such as would exist in the sealed tins, tubes of milk were inoculated and after fifteen hours, aerobic incubation were incubated anaerobically at 37°C. After twelve days the organism was alive and grew well, but after twenty-eight days there was no growth. Had it been incubated at room temperature it would probably have survived longer.

With the apparatus at my command it was not possible to ascertain, with any degree of accuracy, the thermal death-point of the organism.

ACUTE DIFFUSE PERITONITIS.

A Series of Twenty-one Consecutive Cases.

By Major BASIL HUGHES, D.S.O.
Royal Army Medical Corps. (T.F.)

The peritoneal cavity is one large complex bursal sac containing, in addition to several diverticula, the hollow and solid abdominal viscera. The viscera, which are retro-peritoneal, possess a liberal blood supply, particularly the intestine. The main diverticula or pouches are the retro-vesical, the kidney pouches, the retro-cæcal, the retro-sigmoid, the hepatico-renal and the pouches about the termination of the duodenum.

In case of infection it would naturally be surmised that these pouches would form suitable places for the development of sepsis and eventually localized abscesses, but in reality they do not. The peritoneum, however, offers a large area for the absorption of toxins, and the rate of absorption is remarkably rapid, being greater in the upper half than in the lower. The lymphatics are very numerous and eventually form the truncus lymphaticus intestinalis which opens directly into the receptaculum chyli.

Peritonitis is initiated by access of virulent infection into the peritoneal cavity, the organisms being usually intestinal in origin. Peritonitis may be caused either by trauma or disease.

The war has provided abundant material for the study of this grave condition and different findings and disappointments have suggested a treatment that will be detailed directly, which has given most encouraging results in twenty-one consecutive cases.

What actually takes place when infection has gained access to the ritoneal cavity?

The first change is hyperæmia of and exudation into the sub-peritoneal tissue of the part around the infected focus. This is followed by the exudation of a fluid, which rapidly becomes turbid, into the peritoneal cavity in the neighbourhood of the infected focus. What is the nature of the fluid poured out? If the fluid be examined microscopically it will be seen to contain large healthy staining cells, a few polymorphonuclear leucocytes, also staining well, but no bacteria. This can always be demonstrated in fluid present in the case of an acutely inflamed appendix which has not perforated, and for which an early operation has been performed. Further, if the fluid be allowed to stand or be centrifuged, the cellular element will sink and leave a clear supernatant straw-coloured fluid. Cultures have in some instances shown the presence of staphylococci, but it is doubtful if these organisms did not come from the skin. The fluid, differing in no way from that secreted into a large joint after penetration by a septic foreign body, is highly protective in character, and at first possesses bactericidal powers of a first-rate description.

While this fluid is being secreted, nature is making a further effort to localize the diseased focus by the formation of adhesions.

What happens in the case of the intestine? When the gut is damaged, as in a gunshot wound, there is abundant proof that peristalsis is immediately arrested and remains in abeyance so long as it is not further stimulated. In other words, extravasation of intestinal contents will be small in extent, especially if the

patient be given morphia and kept quiet. Transport over rough ground or by motor is sufficient to start peristalsis anew and so increase extravasation, whereby a larger stream of infection gains access to the peritoneal cavity.

It is then possible, though there is no direct proof, that in acute abdominal conditions other than gunshot wounds, peristalsis is arrested or modified.

Should Nature fail in her attempt to localize the inflammatory focus, and should such failure be intensified by treatment, (e.g., the administration of an aperient for a pain in the stomach), then infection will certainly be disseminated, either slowly or rapidly, throughout the peritoneal cavity, and no factor is more potent in bringing this about than an actively peristaltic gut. The whole surface, especially that clothing the intestine, becomes actively hyperæmic and swollen, it loses its lustre, protection fluid is poured out on all hands, lymph of a plastic nature is deposited on the gut binding together coils of small intestine, the flanks and pelvis contain turbid fluid, and the intestine rapidly becomes distended.

The next stage is an impairment of the vitality of the fluid poured out into the peritoneal cavity. The fluid is slowly converted into pus, and this is enhanced by the *increasing intra-abdominal tension brought about by an ever-distending gut, which exerts a serious brake upon the circulation in the vessels of the mesentery.* The rate of destruction of the vitality of the protective fluid depends upon the degree of intra-abdominal tension, the virulency of the infection and the patient's general resistance.

Though the fluid at this stage may be often referred to as pus, it is only partially pus; it is a question of degree, and degree in this respect is a highly important question. It is possible to gauge this degree clinically to some extent by the severity of the symptoms of toxæmia.

It seems that the presence of many plastic adhesions binding together coils of small intestine is of good omen and indicative of a high degree of resistance.

At this particular stage complete resolution may take place with treatment. On the other hand, if the protective fluid dies, it forms pabulum for the bacteria present, and it eventually becomes pus. Septic absorption under these conditions becomes extreme and finally death follows from toxæmia.

There seems to be little doubt that *peristalsis plays a large part in the dissemination of septic material from any one focus throughout the peritoneal cavity.*

Symptoms.—Early symptoms demonstrate Nature's method of coping with the disease. As soon as infection has reached the peritoneal cavity, a splint is applied in the form of a rigid abdominal muscle. There is pain and tenderness coinciding with the hyperæmic condition of the part of the peritoneum affected, and later there is a definite mass to be felt which is formed by adhesions, adherent omentum and the diseased part of the gut. As the condition progresses the tenderness becomes more general; the whole abdominal wall is now rigid, distension sets in, and vomiting commences. Constipation is absolute, there is no passage of flatus, *the urine is diminished in amount and often passed with difficulty.* Vomiting increases in frequency, the patient rapidly becomes dehydrated, there is hiccough and a typical abdominal facies, the tongue is dry and coated, sordes appear on the lips and teeth, vomiting later becomes coffee-ground in variety, the pulse steadily becomes more rapid and thready and finally the patient dies of toxæmia.

Vomiting which increases in frequency has in the case of gunshot wounds proved to be due to an ever-increasing extravasation of intestinal contents into the

peritoneal cavity. Vomiting which continues after forty-eight hours and which is biliary in character is toxic and is Nature's attempt at excretion. Vomiting of the coffee-ground variety denotes a very grave degree of toxæmia and is of very serious import.

Nature, in her attempt to make good, is bound to fail unless helped artificially, as she can make no provision for the fluid lost by vomiting.

Complications.—The only complication to be feared, apart from toxæmia, localized abscesses, and the like, is intestinal obstruction. This may be a later complication and becomes evident by a change in the character of the vomit.

Treatment.—Many authorities have advised treatment on the following lines:—

(1) Removal of the cause at the earliest possible moment.

(2) Drainage of the peritoneal cavity after performing lavage or no.

(3) Abolition of the distension by means of graduated doses of calomel, subcutaneous injections of pituitrin or eserine, turpentine enemata, artificially emptying the distended bowel, and the like.

(4) Control, if possible, of the vomiting by various drugs or stomach lavage.

(5) Administration of saline, either subcutaneously or rectally, and stimulants.

(6) Suitable nourishment.

On (1) all are agreed, but this should be performed with the minimum of disturbance to the gut, and the peritoneum generally.

(2) Can the peritoneal cavity be drained, and if so, what are we draining away? Post-mortem examinations performed both during the war and before (and such examinations during war time have followed very soon after death) show that a drainage tube is shut off like any other foreign body from the general peritoneal cavity within a few hours of insertion. *The degree in which adhesions are thrown out is a very important measure of the degree of the patient's vitality.*

If, then, protective adhesions are being thrown out around drainage tubes, what are we attempting to drain away? A protective fluid of first-rate vitality; in other words, we are attempting to defeat Nature. Provided a case of general peritonitis can receive surgical help early, it is quite sufficient to carefully mop out any obvious pouches in the region of the area of operation with dry sterile swabs and to abandon all forms of drainage.

Should the fluid be frankly purulent, and consequently no peritoneal reaction present in the form of adhesions or deposition of lymph, then drainage may be resorted to; but this type of case is invariably hopeless from the beginning.

It is very unwise to disturb any lymph that may be deposited upon the gut, or attempt to unravel coils of small intestine that are matted together, for the procedure only increases shock and opens up fresh areas for absorption. It must be remembered that matting together of the intestine reduces the area of absorption to a minimum.

No good can ensue from peritoneal lavage, for it amounts to washing away a fluid that is highly valuable at this stage, and, however carefully performed, it aids the spread of infection. It is quite sufficient in the way of drainage to leave a small tube or glove drain down to the primary focus of infection, to be removed at the end of forty-eight hours. This drainage, however, is not always necessary.

(3) What is the significance of a distended intestine? The gut with its serous coat is in a condition of acute inflammation. Its musculature is rendered incompetent, partly as an effect of toxæmia and inflammation, partly as a result of

distension with gas formed by abnormal fermentation taking place within its lumen, again the result of a general toxæmia. Would one suggest to a patient who was suffering with an acute cellulitis of both legs, that he should get up and run about his room to effect a cure? Why, then, adopt such remedies as calomel, pituitrin, eserine and the like as a means of treating an acutely inflamed gut? Moreover, such treatment, by stimulating peristalsis, will further disseminate infection and increase toxæmia. There can only be one rational treatment at this stage, and that is rest. It is difficult to understand the significance of the intestinal contents at this particular juncture. They may exert some useful function, they may not. It is sufficient to say that no apparent harm has resulted from leaving them there, and consequently enterostomy and artificially emptying the distended gut has not been practised in any of this series of cases.

The only method of splinting an inflamed gut is by administering morphia and atropine. A quarter-grain of the former drug is given eight-hourly, and one-hundredth of a grain of the latter drug twelve-hourly. The pupils must be carefully watched, and as soon as constriction shows itself the dosage should be decreased to a quarter of a grain twelve-hourly, and this is usually called for at the end of forty-eight hours. Administration of these drugs is continued until flatus is passed and the patient has ceased vomiting, and this over the series of cases in question has invariably occurred at the end of the fourth or fifth day. It has been suggested that the administration of morphia hinders phagocytosis. If this is true, it does not do so to such a degree, when given to the extent recommended above, as to jeopardize the patient's chances, and clinically this treatment has proved to be sound practice.

(4) Vomiting is a symptom of diffuse peritonitis, and is a method of eliminating toxin. Why devise means for checking it? The character of the vomit is important, and affords a clue to the prognosis. Thus, biliary vomiting which gradually gets clearer is of good omen. Coffee-ground vomiting denotes a more severe degree of toxæmia, and is serious. Should the coffee-ground nature of the vomit change to that of the biliary type (which it did in three cases of this series), then the prognosis is good. If, on the other hand, the vomit becomes fæcal, this denotes intestinal obstruction, and further operation is called for. This latter complication occurred in two cases of the series, and both recovered. In both cases many adhesions were present, and obstruction had occurred at the ileo-cæcal junction. Vomiting at this stage is not so distressing as many would imagine, and the stomach appears to empty itself both easily and painlessly. Vomiting, then, should be encouraged.

(5) Continuous vomiting rapidly dehydrates a patient. To make good the loss of fluid, and to aid in a speedy dilution of toxins, normal saline is employed. This is run in slowly and continuously beneath the skin. The drip is so regulated that undue collection of fluid in the tissues round the needles is avoided. Nine to ten pints can be given in twenty-four hours, and this supply is maintained for forty-eight hours. Swelling of the feet or waterlogging of the lungs must be guarded against. Should the patient be intolerant of fluid given subcutaneously, it may be given continuously per rectum, but the subcutaneous method is the one recommended. At the end of forty-eight hours the patient needs less fluid, and it may be reduced to five pints in the twenty-four hours. The supply of saline

should be maintained until vomiting has ceased. These patients have tolerated continuous subcutaneous saline well when under the influence of morphia.

Copious drinks of water containing sodium bicarbonate and sodium citrate are given by the mouth, and by these means two ends are attained. Firstly, the stomach is washed out without undue distress to the patient; and, secondly, a diuretic action is obtained, probably through absorption of some of the citrate which escapes from being vomited back. At the end of forty-eight hours the patient starts to pass large quantities of urine, and with this is associated an amelioration in symptoms, for the vomiting becomes less frequent, the vomit clearer in colour, and the patient feels better. Stimulants have not been employed.

As soon as the vomiting has ceased, further administration of saline is withheld. The inflammatory condition is now sudsiding, but on no account should purgatives be given. Flatus is now passed, and generally an offensive liquid stool. Bismuth and tinct. camph. co. can be given with benefit as soon as the vomiting has ceased.

(6) For the first forty-eight hours no nourishment is required; saline is all that is necessary. On the third and fourth day glucose is given per rectum. As soon as the vomiting has ceased, Brand's Essence and albumen water sweetened with glucose may be given in small quantities frequently and regularly. Water may be administered *ad lib.* At the end of a week, milk and soda-water, raw eggs, and a little custard may be given, and from this date the diet may be gradually increased. Patients at this stage are often very hungry, but a full meal should not be allowed, as it causes distress or distension. On the tenth or twelfth day castor oil may be given, and from this date all anxiety is usually at an end.

One case from twenty-one consecutive cases of diffuse peritonitis may be quoted here; space unfortunately does not permit of more.

538811 Pte. M., 6 S.L.I. Admitted to 39th Stationary Hospital, January 1, 1919; diagnosed influenza. On admission, symptoms were: persistent vomiting of a greenish material, face sunken, looking very toxic and slightly jaundiced, abdomen not moving with respiration, and legs drawn up. No passage of flatus for thirty-six hours, small quantity of high-coloured urine passed with difficulty. Maximum tenderness in right lower abdominal quadrant, and a tender mass could be felt per rectum on the right side, while the recto-vesical pouch felt full. Pulse, 110, thready; temperature, 102·8° F. Laparotomy performed through right rectus. A gangrenous perforated appendix which was hanging into the pelvis was removed. The pelvis was full of a very offensive fluid, and a concretion was found free in the fluid. Diffuse peritonitis was well established; the intestine was acutely inflamed and distended; large patches of lymph were present on the small intestine, whose coils were matted together. The pelvis was mopped dry, but the remainder of the peritoneal cavity was not touched. A small drain was left for forty-eight hours down to the bottom of the recto-vesical pouch. The abdomen was closed in three layers.

Subsequent History.—Biliary vomiting continued for three days. No passage of flatus until the third night. A very offensive liquid stool passed naturally on the fourth day. Patient developed broncho-pneumonia, but abdominal condition remained satisfactory. Distension had entirely gone at the end of the eighth day.

Tube removed at the end of forty-eight hours. Despite the pneumonia, the patient made a very satisfactory recovery.

Treatment.—Continuous subcutaneous saline up to the third day; copious drinks of water containing bicarbonate and citrate; glucose per rectum; morphia, quarter-grain eight-hourly; atropine, one-hundredth grain twelve-hourly for forty-eight hours, and discontinued after the end of the third day. No aperient until the ninth day. Very light diet up to the ninth day, when diet was gradually increased.

Briefly, the series of twenty-one cases is as follows:—

The cause of the condition was due to appendix abscess in 6; perforated gastric ulcer in 1, penetrating wounds of the abdomen in 8, intestinal obstruction with perforation of the gut in 1, pneumococcal in 2.

There was one death, and this was a case of intestinal obstruction with gangrene of the gut. Most noticeable in this latter case was the absence of any healthy reaction of the peritoneum, and clinically it was a very severe example of general toxæmia.

The two cases of pneumococcal peritonitis both showed symptoms of subacute intestinal obstruction. Median laparotomy was performed, and the obstruction freed.

One case of appendicitis and two of penetrating abdominal wounds were associated with vomiting of the coffee-ground variety.

One case of appendicitis and one of a gunshot wound developed intestinal obstruction requiring further operation. In both there was a healthy peritoneal reaction in the form of plastic adhesions and fluid, and both survived the necessary operation. One case (appendix) developed a fæcal fistula which subsequently closed.

In only one of the cases was the peritoneal fluid frankly purulent, and in all but this one lymph and plastic adhesions were present.

In no case was an attempt made to drain or wash the peritoneal cavity. Nothing was disturbed beyond the necessary area of operation.

No case proceeded to the formation of localized abscesses in the peritoneal cavity.

All (with the exception of the one death) ran almost identically the same course, in that vomiting ceased from the fourth to the fifth day, and flatus was passed about this period. Distension subsided in all by the end of the tenth day; in some cases it was earlier.

The urinary outflow (a very important factor) at first diminished, increased rapidly after forty-eight hours, and with this was noticed a change in the character of the vomit, and improvement in the patient's general condition.

Teatment in all cases was identical, and has already been detailed in the text.

All these patients were nursed in a very slightly elevated potition, with a bolster placed beneath the knees.

THE STORY OF A SPINAL INJURY.

BY A PATIENT, A SOLICITOR, AGED 30.

REMARKS BY MAJOR C. NOON.
Royal Army Medical Corps.

In cases of spinal injuries it is unusual for the patient's symptoms to be accurately recorded. The following account was written by a solicitor, who on three separate occasions suffered from signs and symptoms of spinal injury. For this reason, and on account of the rarity of the case, it would seem that these notes are of sufficient interest to justify publication:—

"On July 21, 1916, while riding my charger at full gallop she put her foot in a rabbit-hole and pecked badly, throwing me violently on the ground at right angles to the direction in which I was travelling.

"I distinctly remember the impact with the ground. I had fallen stretched out at full length on my back, having struck the ground at a point just below my neck, with my head instinctively bent forward to protect it from injury. I at once had a feeling of constriction round the upper half of my chest, and began to gasp for breath, but was unable to take deep breaths on account of the constriction, which gave me a feeling of being tightly bound down. The gasping continued for some time, and for some days later I was unable to fill my lungs completely, and coughing or laughing caused great pain. My next sensation was one of very intense pain in the neighbourhood of the collar-bone, extending as far as the points of the shoulders and round the back immediately below the neck.

"In all the rest of the body below the collar-bone I had no feeling at all, neither had I any notion in what position my limbs were, and I could not raise my head to see, but I had an idea that my arms were raised unsupported in the air from my shoulders. I was told that they were on the ground by my side, and I asked that they might be laid across my chest as I thought that this might relieve the intense pain in my shoulders, and also feared that they might be broken. This was done, but I could not feel them being moved in the slightest. I then tried to move my feet, but was informed that there was no movement discernible.

"Meanwhile some one was chafing my hands, and after about ten minutes (?) I could just feel it when the back of my right (?) hand was pinched, and soon afterwards I was told that my right foot was moving very slightly.

"There was never any loss of consciousness, and as soon as my breathing was under control, I was able to speak rationally. I found that my sight was not affected, and that I could protrude my tongue in a straight line. I remarked jokingly that I had probably broken my neck! I was told my head was bleeding, but I believe this was not a fact.

"IN HOLT MILITARY HOSPITAL.

"I was taken in an ambulance to Holt Military Hospital, where I was laid on a stretcher, and after my boots and leggings had been removed (I could feel this being done) I remained thus for four or five hours, after being given morphia tablets, when I was given an anæsthetic, after which my clothes were removed, and I was examined and a catheter passed. It had been suspected that both of

my shoulders were 'out,' and the pain in the points of my shoulder joints was so severe that I thought it might be so.

"I recovered from the anæsthetic about 5 p.m., and felt slightly sick, but did not vomit, although I was told that I had done so previously. By this time I could feel my hands and feet being touched, although the sensation was very much diminished, particularly on left side, and feeling of constriction round chest was still bad, and there was intense hyperæsthesia of the skin immediately below the collar-bone, which was so bad that I could not bear the friction of my pyjamas; it felt as though a fine mesh of red-hot wires were laid across my shoulders and thorax.

"During the night (21st to 22nd) I was able very slowly to flex my right knee, and to move my right toes slightly. I had frequently to ask that the position of my arms might be changed. I found then and later that the most comfortable position was for my arms to be laid across my chest with the elbows well away from the body.

"CONDITION SEVENTEEN HOURS AFTER ACCIDENT.

"Right knee could be flexed slowly. Movement of right foot and toes. Very slight movement in fingers of right hand. Left knee could be flexed with difficulty. No movement of left foot or toes, fingers or arms. Sensation to touch had everywhere returned, and was numb and 'woolley.' Able to distinguish heat from cold. Sensation above collar-bone line quite normal. Urine retained. Bowels unopened. Knee-jerks exaggerated. Ankle clonus. Bruising on left side of right wrist and forearm, and lower joint of left thumb. Head could be moved from side to side.

"NORFOLK WAR HOSPITAL, JULY 22.

"In about two days' time I could easily flex both knees, move right toes, and fingers fairly well, and left toes slightly. I was unable to move my left fingers at all for about a week. Retention of urine occurred for four or five days, during which time a catheter was passed twice and rarely three times daily. No pus or albumin was detected in urine. After power of voiding urine normally returned, I had slight symptoms (spasmodic muscular contraction and urgent frequent 'calls') of cystitis, and this remained for some weeks, but was relieved by urotropine. Bowels were moved by enema (with difficulty) on the sixth day, and twice more in the next twelve days, once by enema and once after two grains of calomel.

"For the next five or six days temperature was over 102° F., and at times nearly 103° F., after which it dropped to under 100° F., but my night temperature continued at about 99·6° F. to 99·4° F. for some weeks. I was able to take nourishment fairly well although without appetite, and except for the pain (which was agonizing in shoulders and across the upper part of the back when I was moved or touched), I never felt seriously ill, excepting the first day I had an enema, when I was very sick, and had much flatulence, and felt collapsed. I only had one headache the whole of the time I was in hospital, and that was in October.

"Sleeping draughts or injections were given to me nightly for about the first ten days, but even with this I rarely slept for more than an hour or two owing to the pain.

"After about fourteen days from accident, condition as follows:—

"Sleeping much better, but not until about midnight or later. Urine now passed normally. Bowels *very* obstinate. Right leg getting much stronger. Able to hold light articles, papers, etc., in fingers of right hand. Able to raise right forearms from elbow, but only slight movement of upper arm from shoulder. Just able to get right hand up to mouth after great struggle. Left leg stronger. Frequent cramp from thigh downwards when extending left knee after it had been flexed for some time. Now able to close fingers of left hand, and to extend them again with even greater difficulty (I found that if the fingers of my left hand were closed and my left leg straight, my fingers *opened involuntarily* when I flexed my left knee!) Left forearm could now, or soon afterwards, be drawn downwards with difficulty when laid across my chest, but I could not draw it upwards towards my head or raise it at all. When I yawned I was prone to cramp in my left arm, and my fingers would stretch wide open involuntarily.

"By about the end of August I could touch the top of my head with my right hand and write a little, although fingers still stiff and numbed. I had previously experienced difficulty in turning my right wrist outwards, but this was now improving.

"The left side was still very weak, especially finger extensors. Could *just* touch my face with my left hand. Unable to turn left wrist outwards, and the wrist was very much dropped.

"Since movement began to return my hands had been first of all hot and dry, and subsequently very cold (I noticed this first in the right hand, and not until later in the left); and the skin on the palms always felt very dry, with a feeling that the skin was much too tight for the hand, rubbing them with oil or glycerine, or soaking them in water relieved this for a short time. The left leg from this time onwards was very subject to tremors. The soles of both feet had a definite band of partial insensibility, running horizontally across the centre just below the toes; this continued for some time. About this time I first noticed that the tendon of my left big toe was contracted, causing the toe to turn up. It never got stiff, and this condition lasted until I was able to wear boots.

"On August 12, I was moved in a prone position to a bed on the lawn in the daytime, and from the middle of the month I was sleeping and eating well, colour better and putting on flesh. I noticed one day, and subsequently when it began to rain, when I was out, that the raindrops falling on the back of my hand (right) seemed to feel hot instead of cold; I did not notice this in the case of my left hand.

"Between the fifth and sixth week I was able to sit up in bed with help, and my back supported, and I could now perform the necessary offices for myself with little or no help. The pain was now much less.

"About first week in September I was able to get into a wheeled chair with help, and very soon to cut up my own food. Could stand on right leg without support almost at once, but not on left leg for some days. Tremors in left leg and knee now very bad and uncontrollable.

"On September 12, I was able to "walk" for the first time, supported on both sides. Left foot dragged very much when walking, and very prone to turn outwards and toes to turn in. I first began to notice about this time that the sensory feeling of my *right side* was now very much worse than that of my left

(although the reverse was the case as regards powers of movement). When touching the bare skin of my right thigh and calf and buttock in particular, the feeling was diminished as though I had a sheet over the bare skin, whilst the feeling of my left side (excepting in my fingers which had 'pins and needles') was almost normal.

"The drop-wrist condition of my left arm was now cured, but I still had difficulty in turning my wrist outwards. Left thumb now very painful and stiff and X-ray examination revealed that one of the metacarpal bones was cracked. Bowels were still most obstinate and only moved by taking aperients in large quantities, the cause being, I am convinced, lack of power to expel the motion by straining.

"About this time I frequently had pain (rheumatism or nerves) along the outside of my left thigh; this was usually worse when I was warm and in bed.

"Second week in October. I could now walk up and downstairs one step at a time with the right foot leading, but was unable to lead with the left foot, owing to a stiffness in ankle joint, and weakness in left knee. The tendo Achillis of left foot used to get very sore after walking. Tremors in left leg less frequent now, but still persist. I found myself at this period very 'jumpy' and easily startled.

"Right leg now very sensitive to pressure, particularly the knee; thus if I pressed my right knee against a table leg sharp pains shooting up the inside of my leg, starting from the point of contact, were experienced. I never noticed this in the case of the left leg.

"Sensation of right limbs still bad, particularly the ulna side of the right hand, this part frequently 'going to sleep' while the rest of the hand is normal.

"Movement of left arm now much better, but I still could not raise left arm above my head and could only turn the left wrist over with difficulty.

"The pain in my shoulders had now concentrated in a point just below the clavicle of each shoulder, and was more in the nature of a deep-seated painful itching; this was always worse in the early morning, on awaking.

"I was discharged from hospital on October 14.

"My weight was now ten stone, exactly fourteen pounds below my normal.

PRESENT CONDITION (JANUARY, 1916).

"I have just been before a medical board, which has given me a further month's sick leave.

"An eminent neurologist, whom I consulted just before Christmas, says that I am making very satisfactory progress, and that I shall be *absolutely fit* in the course of a few months, but that I shall not be fit for duty for 'at least three months.'

"Knee jerks still exaggerated. Inclined to drag left foot a little still when walking, but can walk two miles in my own time. Limbs on right side perfectly strong, but sensation still diminished, particularly in thigh, buttock, and top of right foot, which feels 'woolley.'

"Grip of right hand very strong. Ulnar side of right hand frequently numbed. Fingers of both hands still tingle, particularly when I am tired. I cannot wear wool next my skin, it sets my teeth on 'edge.'

"Left arm still a little stiff at the shoulder, and unable to lift anything heavy.

Sensation to touch on left side normal except in fingers (here again the ulna side is the worst). Extensors of fingers of left hand still bad. Broken thumb still very painful when moved and muscles much contracted. Left ankle stiffer than normal. Movement of head not so free as before accident. Bowels still troublesome, and pills or medicine have to be taken regularly, this due to inability to strain. Pain just below clavicle in both shoulders occasionally, especially on awaking. Tremor in left leg very rare now, and chiefly occurs on awaking. I occasionally get queer sensations of pricking, burning, etc., which make me jump violently.

Particulars of Previous Accident in 1908.

"I had a very similar (but much less severe) accident in 1908, caused by a fall with my horse when hunting. I was then pitched over my horse's head on to my back, and lay on the ground for about ten minutes, feeling numbed all over, and unable to move hand or foot. I do not think that sensory feeling was ever lost on that occasion, but it was six weeks about before I recovered full use of my left arm, although my right arm recovered more quickly. I experienced very intense pain just below my collar-bone back and front, as well as in my shoulders, and it was many months before I quite got rid of it.

"There were no bones broken, and a local practitioner diagnosed 'bruised nerves,' it never being suspected that my spine might be injured.

"I had also had a similar accident about a year previous to this when playing Rugby football at Oxford, but although movement of left limb was affected and I had girdle pain for about a week, there was no paralysis."

Remarks.

This case was admitted to the Officers' Ward at the Norfolk War Hospital on July 22, 1916. The medical man who first attended the case suspected that it might be one of traumatic neurasthenia. In other words that the signs and symptoms complained of were functional. The account of the case and its progress seem to be worthy of record. Firstly, because it is written by the patient, and secondly, because of the difficulty in arriving at a diagnosis.

In conditions of traumatic neuroses three types of cases may be recognized, namely: (1) Cases of simple traumatic neurasthenia; (2) cases with marked hysterical features; (3) cases in which the symptoms and signs suggest an organic lesion.

It is difficult to imagine that a large functional element did not play an important part in the production of the signs and symptoms in the above case, but that there may have also been some organic lesion of the cord, I think cannot be excluded, owing to the presence and persistence of a well-marked extensor response (Babinski signs).

COLLOIDAL MANGANESE IN GONORRHŒAL OPHTHALMIA.

By Captain DONALD McFARLANE LIVINGSTONE.
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It will be generally conceded that the treatment of gonorrhœal conjunctivitis in its severer forms brings but little satisfaction to the ophthalmic surgeon, and any remedy which promises to control the disease more effectively is worthy of a prolonged test.

There is available in colloidal manganese a remedy which I have recently used in three cases of gonorrhœal ophthalmia and all have made excellent progress; the last case which is reported here being especially noteworthy both on account of its severity and the splendid result obtained.

There is no need to recall in detail the usually accepted forms of treatment for this disease. For the past three and a half years I have had under my care in this hospital many cases occurring in adults. The local treatment adopted was varied from time to time. A group of cases were treated by gonococcal vaccine in addition to local measures, but whether vaccines were given or not, there seemed to be little difference in the results taken as a whole. Gradually, however, I became convinced of the uselessness of silver nitrate in combating the disease, and discarded its use in the more severe types with much swelling, for in these it invariably appeared to aggravate the condition.

In gonorrhœal ophthalmia, the most dangerous period is during the first few days of the infection, when owing to the swelling of the eyelids, and bulging chemotic ocular conjunctiva, the cornea is obscured over the whole, or most of its area, and the removal of discharge from its surface is made difficult or impossible. The continued bathing of the cornea in this discharge introduces the most serious factor, for the corneal epithelium is damaged principally by the action of the gonococcus or its toxins, while the nutrition of the cornea as a whole is also injuriously affected to some extent by the excessive swelling.

It seems certain that the main effort of treatment in this stage should be directed towards controlling and abating the violent reaction to the gonorrhœal infection, by bringing about a rapid decrease in the conjunctival swelling and so allowing of thorough yet gentle cleansing of the whole eye by non-irritating collyria. The use of any drug which by its action would tend to increase the swelling is contra-indicated.

Colloidal manganese appears to act in the manner required. This drug was recommended and given by Captain J. E. R. McDonagh in my last three cases with favourable results. The first case was not of great severity, but its action appeared satisfactory. In the second case it was not given till corneal ulceration had set in, but the eye healed rapidly and swelling and discharge abated during its use.

The third case was of a most virulent type and the effect of colloidal manganese given from the beginning for the first time was most striking. Pte. J., aged 24, admitted December 24, 1918, with gonorrhœal ophthalmia of the left eye. Two days previously he felt his eye pricking and the following morning—the day before admission—the eyelids were swollen and difficult to

open. On admission both lids were greatly swollen and almost solid, so that they could only with difficulty be separated. There was great tenderness and pain and the surrounding cheek was also red and swollen. On opening the lids, the cornea was completely hidden by overlapping folds of œdematous bulbar conjunctiva. There was an abundant discharge of thin pus. The eye was bathed hourly during the day with warm boric lotion, and two-hourly during the night. Ten per cent argyrol was used six-hourly. An injection of one cubic centimetre of colloidal manganese was immediately given by Captain McDonagh, intramuscularly into the buttock. On the 25th there was a slight improvement, and a little part of cornea could be seen. The lids were more easily parted. On the 26th still a slight gain; on the 27th one cubic centimetre was given as before, and by the following morning the patient expressed his delight in the almost complete absence of pain. The change was striking; all swelling of the bulbar conjunctiva had completely vanished; the œdema of the eyelids had greatly lessened and the discharge had also become noticeably less in volume. The cornea was perfectly clear with its epithelium intact over the entire surface, and the eye was apparently out of danger. On the 31st a third and last injection of one cubic centimetre of colloidal manganese was given and by January 9 the conjunctiva had become almost normal and discharge practically had ceased, except for gumming of the eyelids after sleep.

The appearance presented by this case on the day following the second injection of colloidal manganese was in truth surprising. Over a fairly wide and long experience in the treatment of gonorrhœal blenorrhœa it had never previously been my good fortune to witness such a dramatic change, resulting one may conclude from the use of the injection of colloidal manganese.

No local measures with which I am acquainted would have brought about such a satisfactory termination.

It is hardly necessary to emphasize the danger which results in drawing inference regarding results obtained by any remedy used in a small number of cases. Obviously a prolonged use of the drug is required before definite conclusions of value can be arrived at which will stand the test of time. But nevertheless it is well to avoid cultivating the habit of mind which sees the perfection of achievement in everyday methods already in use, and refuses to recognize their defects. Where treatment is too often followed by indifferent results, as in gonorrhœal ophthalmia, the need for fresh endeavour becomes insistent. In future I shall use colloidal manganese in the belief that it represents a decided advance over former methods of treatment.

In conclusion, I have to express my indebtedness to Captain McDonagh for his valuable assistance in the treatment of these cases; also to Lieutenant-Colonel W. Turner, C.M.G., officer commanding Connaught Hospital for permission to publish these notes.

A CONTRIBUTION TO THE PATHOLOGY OF PELLAGRA.

By H. E. ROAF, M.D., D.Sc.
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In August 1918 I was sent by the D.M.S., E.E.F., to No. 2 Prisoners of War Hospital, Abbassia, to investigate pellagra amongst the prisoners of war. In addition to other lines of work I collected the material on which I now wish to report.

With the collapse of the Turkish Army in Palestine the increase in the number of prisoners made the care of their health an important problem, therefore the D.M.S. appointed a committee to take over the work that I had commenced. Although I continued to collaborate with this committee I did not collect any further material as I was busy with other aspects of the same problem [5].

The symptoms of pellagra suggest that the common underlying defect is in the sympathetic nervous system. At the same time diet seems to be related to the onset of this disease.

The relation of these factors to the production of pellagra is given in the hypothesis that guided me in my work before the D.M.S. appointed his committee. The hypothesis was as follows: (1) Pellagra is associated with diets containing maize. (2) The experiments of Hopkins and Willcock with rats fed on zein the chief protein of maize showed that the absence of tryptophane and lysin from the diet made it insufficient to maintain life [9]. That other proteins than those of maize may be inadequate to prevent the symptoms of pellagra is shown by the work of Wilson, who finds a relation between the "biological value" of the protein in the diet and the occurrence of pellagra [10]. (3) The symptoms of pellagra show a great similarity to those of Addison's disease and this similarity caused Sandwith to suggest in 1913 that pellagra may be due to an insufficient supply of adrenalin caused by a deficiency of aromatic amino-acids in the diet [6]. (4) The characteristic symptoms of pellagra are such as might be produced by abnormality in the activity of the sympathetic nervous system. Many quotations from Marie can be given in support of this statement but it is sufficient to point out (*a*) that all efferent fibres to the skin (vaso-motor, sudo-motor, etc.) are sympathetic in origin. Thus interference with the normal activity of the sympathetic system may lead to abnormal response to stimulation such as the skin symptoms produced by strong sunlight and pressure. (*b*) The sympathetic is inhibitor to the intestinal muscles but excitor to the intestinal sphincters, therefore deficient activity of the sympathetic will cause diarrhœa such as is found in pellagra.[1]

The early symptoms of pellagra are variable and evanescent, so much so that they suggest functional changes (showing over and under activity) and they might be ascribed to neurasthenia of the sympathetic nervous system. In advanced cases the symptoms suggest that the changes have become organic.

Adrenalin stimulates the activity of the sympathetic system by acting on the sympathetic nerve endings, but we do not know whether activity of the sympathetic

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[1] The above arguments are not conclusive because the diarrhœa may be caused by intestinal putrefaction which does occur in pellagra, and it is extremely difficult to disentangle cause and effect in such complicated conditions, but they were sufficient to form the basis for a working hypothesis.

requires a constant supply of adrenalin. Presuming such to be the case we see that excessive activity of the sympathetic system will require a larger supply of adrenalin and a deficient supply of adrenalin precursor will cause an earlier exhaustion of the adrenal medulla, therefore an earlier failure of the sympathetic system.

Thus we see that there may be two factors which may tend to cause pellagra:—

(*a*) Deficient absorption of aromatic amino-acids.

(*b*) Excessive activity of the sympathetic nervous system, e.g., excessive sweating due to over-exertion in a hot climate.

The Materials.

In order to form a comparison I obtained adrenals and sympathetic nervous systems from cases some of which had been diagnosed pellagra and from others which apparently had not had pellagra.

In dealing with this material it must be remembered that an acute case of pellagra may not have lasted long enough to produce histological changes and that a case with some other diagnosis may have been a quiescent and unrecognized case of pellagra. The prisoners of war had all been subjected to the same conditions of diet and war-strain, thus the main difference was whether they showed symptoms of pellagra.

These complicating factors reduce the likelihood of finding marked differences and if the differences which I find in these few cases are genuine much better results should be obtained with better-marked, long-continued cases such as I saw in Abbassia Asylum.

The adrenals were dissected out, cleaned from all visible connective tissue and weighed. Each adrenal was cut through its central portion from apex to hilum, so that a narrow strip was obtained from the most central portion. These two pieces (one right, one left) from each case were fixed in 3 per cent potassium bichromate containing 4 per cent formaldehyde, put through paraffin, embedded in the same block and cut.

The sympathetic chain of ganglia was dissected out, put through the same process as the adrenals and sections were made from various ganglia.

The Adrenals.

Earlier investigators have not found any distinctive histopathological changes in pellagra.

An assay of the amount of adrenalin was not attempted because it was thought that terminal infections would use up any adrenalin that might be present and thus mask any slight changes that might be due to the pellagrous condition.

Long continued insufficient supply of raw materials should lead to atrophy of the organ, hence the adrenals were weighed to see if their weights might give some evidence of atrophy.

Table I shows that on an average the adrenals from cases of pellagra are lighter than from cases who died from other causes. All cases of pellagra in which other diseases were proved to be present were excluded. Diarrhœa was considered to be a symptom of the disease unless true dysenteric conditions were present. Conjunctivitis was not considered to be a sufficiently severe complication to warrant a case to be excluded from the list of pellagrous cases.

The weights of the kidneys are given in order to show that the difference in weight is not due to the smaller size of the individual cases.

Sections stained with hæmatoxylin and eosin were examined, but no marked differences could be seen between the two sets of cases. In both sets the chromaffin tissue was small in amount: the cortical and medullary cells were shrunken. Such changes are explicable on the assumption that one is dealing with a population in which similar dietetic deficiencies are causing similar changes.

TABLE I.—WEIGHTS OF ADRENALS AND OF KIDNEYS IN CASES OF PELLAGRA AND IN CONTROL CASES.

Case No.	Adrenals in grammes			Kidneys in ounces			Remarks
	Right	Left	Both	Right	Left	Both	
				Pellagra Cases.			
32	6·7	6·7	13·4	6·5	6·5	13·0	..
23*	6·7	5·5	12·2	4·5	4·5	9·0	Colitis
9	5·2	6·2	11·4	6·0	5·5	11·5	..
5	4·9	6·2	11·1	5·5	5·0	10·5	..
30	4·9	5·8	10·7	3·5	4·0	7·5	..
13	4·2	4·9	9·1	5·0	5·5	10·5	..
22*	4·6	4·6	9·2	3·0	3·0	6·0	Conjunctivitis
20*	3·9	4·9	8·8	4·0	4·0	8·0	..
17	3·9	4·2	8·1	5·0	4·5	9·5	Conjunctivitis
11	3·6	4·2	7·8	4·0	4·0	8·0	..
16	3·6	3·9	7·5	4·0	4·0	8 0	..
24	3·9	3·2	7·1	4·5	5·5	10·0	..
31	3·2	3·9	7·1	3·5	4·0	7·5	Conjunctivitis
26*	2·9	2·9	5·8	5·5	5·0	10·5	..
..	Average	..	9·2	..	..	9·1	..
				Control Cases.			
21	7·1	8·4	15·5	5·5	6·0	11·5	Pulmonary tuberculosis
6	5·8	6·7	12·5	4·0	5·0	9·0	Dysentery and tuberculosis
10	6·2	6·2	12·4	4·0	5·0	9·0	Tuberculosis
29	4·6	6·5	11·1	6·0	6·0	12·0	Broncho-pneumonia
12	6·2	4·6	10·8	4·0	4·5	8·5	Scurvy
14	4·2	6·5	10·7	4·5	4·0	8·5	Pulmonary tuberculosis
15	4·6	5·8	10·4	3·0	3·0	6·0	,, ,,
19*	4·6	5·8	10·4	4·5	4·5	9·0	Broncho-pneumonia and tuberculosis
25	4·6	5·2	9·8	4·5	5·5	10·0	Dysentery
27	5·2	4·6	9·8	6·5	7·0	13·5	Tuberculosis
28*	4·2	4·2	8·4	4·0	4·0	8·0	Debility
38*	3·9	4·6	8·5	4·0	4·5	8·5	Pulmonary tuberculosis
..	Average	..	10·9	..	..	9·4	..

* Indicates those cases in which the sympathetic nervous systems were dissected out.

On the whole the group of specimens from the pellagra cases seemed to show greater shrinkage of cells and more marked hyperæmia. Hyperæmia of adrenals with increase in weight has been noted in other dietetic deficiencies [2], but the greater hyperæmia of the pellagra adrenals combined with their lesser weight will make the net weight of adrenal tissue even less in proportion to that of the non-pellagrous specimens.

Although these adrenal changes are not marked it would be interesting to obtain specimens from cases of longer duration, as one might find a definite fibrotic condition in such cases; that is, the functional condition of the adrenal in pellagra may become the definite organic condition of Addison's disease.

The Sympathetic Nervous System.

In contrast with the indefinite findings in the adrenals, the sympathetic nervous systems showed distinct differences. The most striking difference was that in the four pellagra cases the ganglion cells were plasmolysed, so that vacant spaces or large spaces with small shrunken cells were found, whilst in the other three cases the ganglion cells completely filled nearly all the spaces which they should occupy. Chromaffin granules were seen in the ganglion cells of both sets of specimens. If this condition of affairs were persistent, the non-medullated nerves belonging to the plasmolysed cells ought to atrophy and be replaced by connective tissue. Such changes may be shown in more chronic cases and in Addison's disease. The sections of the sympathetic nervous system were stained with van Gieson's stain in the hopes of showing some connective tissue, but no definite connective tissue fibres could be recognized.

The results obtained are so interesting in relation to the hypothesis that prompted the investigation that the matter is well worth pursuing further. As I shall not be in a position to obtain more material, I sincerely hope that someone more fortunate may be able to investigate the following problems.

(1) Is the wasting of the adrenals in pellagra more marked than the wasting of the other organs?

(2) Are the pellagra adrenals more wasted than the adrenals from cases of other wasting diseases and does fibrosis occur in the later stages?

(3) Are changes in the sympathetic nervous system characteristic of pellagra or do similar changes occur in other diseases in which the sympathetic nervous system might be expected to be implicated (e.g., Addison's disease, shock, heat exhaustion, etc.)? In this connexion it is to be noted that W. Hale White found similar changes in the sympathetic ganglia [8]. Some of the results of derangements of the sympathetic nervous system are described by Langdon Brown [1].

Morse has found changes like those described here in two cases of pellagra [3], but the changes found in the central nervous system are like those produced by chronic toxæmia [4] or malnutrition [7].

Summary.

The results obtained suggest that (1) the adrenals are lighter in pellagra than in other wasting diseases; (2) most of the adrenals seem to be abnormal; (3) in pellagra the sympathetic nervous system shows definite histological changes.

It seems as if the Turkish prisoners of war had suffered from such nutritional changes that their adrenals were defective in activity, and that in those who had additional strain thrown upon them the sympathetic nervous system became exhausted with the production of the symptoms of pellagra.

During the course of these investigations I had the advantage of advice from many who know much more about pellagra than I do. Amongst these I wish especially to thank Lieutenant-Colonel P. S. Vickerman, R.A.M.C., Officer

Commanding No. 2 Prisoners of War Hospital, Captain J. Enright, R.A.M.C., Dr. J. Warnock, Dr. R. G. White, and Professor W. H. Wilson.

I also wish to mention the invaluable help that I received from my laboratory attendant, Pte. H. Hulson.

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Lecture.

DEFENSIVE SCIENCE IN GAS-WARFARE.[1]

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INTRODUCTION.

WHEN I received from the Governors of this historic Institute their flattering invitation to deliver an address to-night, the gloomy prospect of my shortcomings was brightened by an occasional—a very occasional—cheering ray. Foremost among such was pleasure that this distinction had been conferred upon an officer of the corps to which I have the honour to belong, and whose Director-General marks his appreciation of the compliment by his presence to-night—as I vainly essay to follow the long train of distinguished predecessors to whom this opportunity has been accorded.

The last occasion on which I spoke on this subject was on the voyage to Egypt, when the adjutant posted a notice in these terms:—

"LECTURES.
". . . Poisonous gas, by Major Lelean"!

To-night, by contrast, I am embarrassed by being allotted a title for my address which is so attractive to a lecturer, and so dangerous to an audience, that an all-night sitting would be required to deal faithfully with it. With your consent,

[1] An Address delivered on February 3rd, 1920, to the Students of the Sir John Cass Technical Institute, on the occasion of the Annual Prize Distribution.

therefore, I propose only to consider the defensive aspects of gas-warfare; taking, stage by stage, the problems that arose, the application of scientific methods to their solution, and the resultant defensive appliances. Even so, the items selected for discussion can only be illustrative; an inclusive presentation cannot be attempted.

(A) The Onset of Gas-Warfare.

It is interesting to recall the manner in which these problems were first forced upon our attention at the Royal Army Medical College.

On April 23, 1915, the Press galvanized the civilized world into just anger by the news that the Germans had broken their pledged word to observe the "Laws and Customs of War," which, *inter alia*, forbade the employment of poisons as a means of injuring an enemy; and that their stealthy preparations had culminated in the use of poison-gas on a large scale against our troops in France.

A little later that same morning a reporter from one of the leading evening papers visited us in search of what is, I believe, known as "local colour." He proved wonderfully quick in the uptake; his head only shared the fume-cupboard for a second or so with a basin of bromine, but in that time he had—judging by his subsequent language—absorbed sufficient local colour to tinge a whole edition of the *Night-jar*, to say nothing of a mere leading article. One must be charitable, and conclude that his departure without even thanks for the subsequent administration of ammonia and chloroform-vapour was merely due to haste induced by fear lest the hue should fade before he got it into print.

Later that day there arrived a report, written on the scene of the attack just after dawn, which gave the most lurid glimpse that I have ever had into the terrible inferno caused by this fiendish device of modern war. The chlorine cloud was blown obliquely towards and into three of our trench lines. Those on the right flank got little. Those in the centre bore the full brunt, and not a man remained conscious when the reinforcements crept up just before dawn; the dead could be dimly seen through the green, heavy gas that still lurked in the depths of the trench, while a few dying lay livid and gasping upon the parapet whither they had crept in their agony. On the left, the position and the lives of his detachment were saved by the resource of a young officer in command, who ordered his men to leave their trenches and open rapid fire over the parapet—in the hope that the explosions would lift and dissipate the gas cloud. Hearing this volume of fire, the listening enemy concluded that the gas attack had failed, and feared to rush the position before dawn, by which time reinforcements had come up and made the position safe.

In view of uncertainty as to the imminence and magnitude of the next gas attack, demands from the front for means of protection for troops were necessarily urgent in the extreme; it was obvious that front-line divisions must be protected forthwith if they were to hold certain positions of vital importance. It is probable that never in our military history had so critical a situation arisen with such dramatic abruptness. The menace was one which could be met—if at all—only by the aid of those possessing the requisite scientific knowledge. In this emergency the War Office authorities turned to the Army Medical Service, and it was largely owing to the high scientific attainments and unfailing resource of Colonel (now Sir William) Horrocks that this menace was met, and disaster to our arms averted at that critical juncture.

For the moment the urgent necessity of affording protection against chlorine gas dominated the situation. The chemical problems were therefore simple, but those involved in providing so great a supply of protective appliances in a few hours were sufficient to tax to the utmost every available resource of improvised organization. Materials and chemicals had to be located, purchased, and assembled; cotton-waste wads had to be stitched in their muslin containers; the resultant pads then had to be dipped and dried; finally, packing, transport, and distribution had to be arranged for at lightning speed on the same huge scale.

Experts—then as always—were eager to assist, but had to be mobilized. At the Government clothing factory employees worked day and night as the buyers maintained supplies. A fleet of cars rushed the pads to and from the great private laundries where they were dipped and dried. The universal response to the call of the State at need was such that 98,000 pads were available at the front within sixty hours; 300,000 within a week; and 2,000,000 within a month. Truly this was a notable achievement in view of the fact that this breach of faith by the enemy was so astounding a bolt from the blue.

Meanwhile those at the front had not been idle. All varieties of improvised devices were evolved to bridge the period of imminent danger before the appliances so anxiously awaited could begin to arrive. Pads to cover the mouth and nose were made from handkerchiefs or from socks filled with earth; respirators were made from beer bottles with the bottoms knocked off and the interior filled with earth or charcoal. A great variety of fluids were used for wetting these devices, and it is interesting to note that textiles merely moistened with water and glycerine will absorb as much as seventy-five per cent of chlorine at one per thousand strength over an hour's exposure. But it was well for us that the enemy had so little gauged the probable tactical value of his new art in war that he had not got up sufficient reserves to renew the attack on a large scale before we were prepared to meet it.

The form of pad supplied is demonstrated by this specimen of those first issued. They were charged with sodium thiosulphate (the "hypo" of photography), which was kept moist by the hygroscopic properties of added glycerine. They certainly afforded some measure of protection, although support is afforded to the cynical suggestion that their value was mainly moral by the fact that some battalions were found wearing the pads on the back of the neck and the muslin over the mouth!

(B) Gas-Warfare as fully established.

It was obvious that gas attacks were definitely established among the horrors of war, and that they differed from other novel methods of attack in that they might at any time be renewed by use of modifications against which existing means of defence would be absolutely ineffective.

Certain defects in the pads supplied as a purely temporary device indicated that they could only be regarded as such. If the difficulty of fitting them closely around the nose and mouth were surmounted, they still failed owing to admitting too little air or too much gas. The area for air-admission being so small, it could only carry an effective charge of gas-absorbent if made so thick as gravely to impede respiration. It was found that the greatest permissible obstruction

to breathing was equivalent to a pressure of about 0·5 inch of water, and that the maximum amount of "hypo" which a pad of the corresponding thickness would contain was only sufficient to protect against anticipated chlorine concentrations for a maximum of ten minutes. As chlorine attacks of greater intensity and duration were expected, and as a variety of other gases might be used against which "hypo" would be wholly ineffective, it was obvious that the pads could only be regarded as palliatives, and that the need for a better protective appliance was little less urgent than at the outset.

Two cardinal essentials were obvious—to enlarge the area of filtration, so that inspired air would be afforded longer contact with gas-absorbents as it passed slowly through, and to impregnate the filter with the maximum amount of absorbent effective against the greatest possible number of gases; or, in other words, to make it "polyvalent."

To the solution of these problems every energy was bent. At first there were only the workers at the Royal Army Medical College, and they had eight hours' rest in forty-eight until the critical fortnight was passed. If I draw mostly upon the experience there, where the defence work done at home was concentrated, it is for that reason: it is not from any lack of appreciation of the efforts of others, at home and overseas, as more and more were mobilized for this research and brought all the wealth of their scientific knowledge and splendid devotion to bear upon it.

In this and in succeeding sections it is perhaps best to take certain problems and consider in detail how they were met.

(*a*) *Extension of Filtering Area.*—This was obtained by substituting a helmet for the pad, thus providing 3½ square feet available for air-entry during inspiration, with the result that resistance to inspiration was reduced from 0·8 inch to between 0·3 and 0·5 inch, and the air-current was so slowed that the absorbent solution had time to neutralize the gases present.

(*b*) *Shortage of Textile of the Requisite Texture and Colour.*—Demands for khaki woollen textile for manufacture of so large a number of these helmets soon exhausted available supplies; buyers had difficulty in obtaining long lengths, and were finally reduced to purchase smaller and smaller oddments in order to keep the workers supplied. It was found that the texture of these oddments varied so much that some let gas through freely while others could with difficulty be breathed through. At first sample helmets were rapidly made from each length, and tested by being worn while the wearer ran a given distance around the College yard in a given time. For the sake of speed, they were then made without eyepieces, and it afforded sightseers much interest to watch hooded privates tearing blindly around the barrack-square, each guided by an attendant holding his arm. But when some 240 samples had been thus practically tested in a few days, the tax and strain grew too great, and the ever-increasing flood of samples began to cause delay. A manometric device was then made for rapid testing, and the above quoted pressures were worked out so that a standard was established for mechanical testing.

But the difficulty of colour was not so easily met. It was necessary that the front-line men should not wear light-coloured helmets affording an opportunity to enemy marksmen, and it suddenly became an acutely urgent problem to determine whether an equally dangerous check in manufacture could be obviated by

simultaneous impregnation and dyeing of the light textiles that were suddenly found to be alone available.

At mid-day one Saturday we were suddenly asked if dyes (aniline or vegetable) and mordants would affect the absorbent solution, immediately or remotely. (These conundrums seemed usually to arise on Saturday afternoons, when telephones were hung up for the office week-end by most firms.) I was just in time to ring up a big dyeing firm and ask their advice. Within two hours their chemical expert dashed up with a car full of dyes, mordants, testing oddments and works of reference. Far into the night we were at work—mixing, dipping, dyeing, testing—but next morning laundries had their orders and their dyes, and all danger of even an hour's delay was obviated. That is just one among a host of illustrations that I could give you of the response that was accorded to every appeal that we made for the best expert advice available.

(*c*) *Selection of the Absorbent Solution.*—At this very early stage, research had hardly been begun, but there was fear of the imminent use both of sulphur di-oxide as a gas and vitrol as a spray—either of which would render "hypo" useless, while the latter would render it actually dangerous. Consequently, sodium carbonate was then added to the solution, already containing thiosulphate of soda and glycerol. A certain amount of "polyvalency" was thus early secured in the embryo helmet, gases being removed both by chemical and physical action.

(*d*) *Material for Eyepieces.*—The adoption of helmets having made eyepieces essential, much difficulty cropped up before satisfactory windows were secured. Mica proved too brittle, and ordinary celluloid was too inflammable. "Non-flam" cellulose acetate was tried, but the promised supply of 100,000 sheets only resulted in 7,000 being forthcoming; moreover many pieces were spoiled by the use of needles too large for the thread, so that minute holes around the stitches admitted unfiltered air freely.

An attempt was made to evolve sheets of chromicized gelatine which would resist vitriol for an interval, and would not get clouded by steam, but no practical success was obtained. Then an ingenious device was adopted of glass disks fixed in tin rims that clamped the textile of the helmet firmly by being screwed into flanged collars, so that, on screwing home, the textile was compressed between the two flanges. Finally, non-splintering "triplex" glass was adopted and proved most successful.

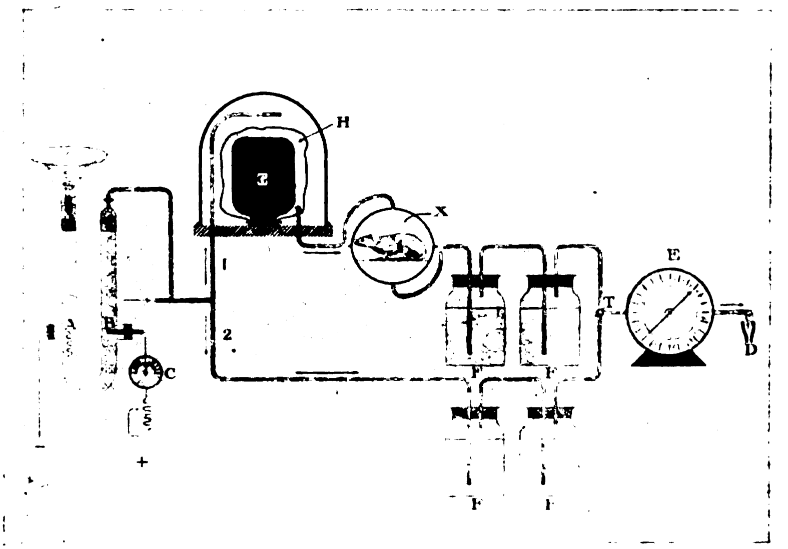
At first the windows were cleared of steam by the wearer dimpling a fold of the helmet with his thumb, and using it to wipe them with, but later a special paste was produced which prevented steam condensation.

(*e*) *Apparatus for Testing Efficiency and Reliability.*—The need for some more reliable method than inspection for proving the reliability of helmets upon which the lives of our men depended was unpleasantly demonstrated by discovery, after many helmets had been made and much celluloid wasted at a time when it was "more precious than fine gold," of the fact referred to above of the thread being too small for the needle-holes. This eluded detection by inspection, and we were compelled to evolve some means of testing samples of each batch of helmets made. This was also made desirable by the wish to prove both the percentage of gases removed by certain solutions and the length of time for which helmets were effective against certain gases. As chlorine then held the stage, we had to

evolve some apparatus for testing helmets against this gas. The final product is illustrated by a diagram, showing the essential points, as follows :—

Chlorine is liberated from hydrochloric acid by electrolysis, the useless hydrogen being evolved at the platinum cathode (A) and escaping into the air. At the carbon anode (B) chlorine and a little oxygen are liberated, and the amount of chlorine was determined by very precise titration. It was found to be remarkably constant for certain currents, as determined by an ammeter (C). As long as the current remained constant, the necessary amount of chlorine could thus be maintained constant for an indefinite period.

Air is sucked by filter-pumps (D) through the whole apparatus at the normal human respiratory-rate, taking up *en route* sufficient chlorine to form a one per cent mixture. After adjustment of the water-taps this also was found by pneumometer (E) to maintain a constant flow indefinitely, being dependent upon a fairly constant head of water-pressure.



The one per cent chlorine mixture could then, by means of a three-way tap (T), be directed along one of two alternative routes (1) and (2), each provided with a series of bottles (F) containing iodide solution, by which chlorine in the air bubbling through it was absorbed for titration controls. One of these circuits contained a dummy head (G), on which the helmet (H) was placed so that the gas was drawn through it before passing through the parallel series of Drechsell's bottles for absorption.

By comparison at intervals of the titration figures of the two sets of bottles, the percentage of chlorine in the air mixture and the proportion removed by passage through the helmet could thus be precisely determined for as long a period as was desired.

When the highly poisonous gases about to be discussed came into use, the apparatus was modified to deliver those gases in like amount by a device

to secure constant temperature and pressure in a connected chamber in which capsules of the liquefied gases were broken.

There was also introduced into the circuit a desiccation chamber (X) in which a rat could be exposed to the gas mixture after the latter had passed through a helmet impregnated with absorbent solution. When titration showed that a new solution being tested was giving what was hoped would prove a satisfactory absorption, a rat was placed in the circuit, and thus exposed to the same percentage of residual gas as would be a man inspiring through the helmet at normal rate, while observation was maintained to see the effect on the rat for a standard period of one hour. Subsequent stages of the investigation will be considered later, but it is convenient here to complete the description of this invaluable apparatus, of which several sets were fitted up so that, when the need was at its height, work was maintained by a dozen investigators simultaneously.

The helmet in use at the end of this stage could be donned in from four to six seconds, and at any given time afforded ten times more protection than the pad, while its effective "life" against one per cent of chlorine was five hours, and it was actually worn continuously for three hours in that concentration of chlorine in the test chamber.

Within three weeks of the first gas attack 300,000 of these helmets had been made and issued to our men, and from that time onward progress and anticipation never failed to maintain the supremacy of our defence over enemy gas attacks. Encouraged by their initial success, the enemy made strenuous efforts, and hoped to overwhelm us by use of such enormous amounts as twenty tons of chlorine per mile of front, but although the next attack lasted four hours I believe that it did not cost us a single life.

(C) Introduction of More Deadly Gases.

A separate section is necessary to deal with the advent of highly toxic, paralysant gases—in distinction to the irritant asphxiant gases first used.

Constant rumours—many doubtless of Hun origin—kept coming in from our secret agents that huge preparations for an overwhelming attack by some still more lethal gas were nearing completion. Expert advice from our industrial chemists enabled us to dismiss many of these rumours, as the gases were impossible of manufacture on the necessary scale, but there still remained practicable an alarmingly long list which our chemists, physicists and physiologists agreed were possible of use in effective concentration against us. Little realizing what was involved in the request, the combatant authorities passed on each fresh report, with a red double-urgent label attached and a request to add to the helmet some neutralizing substance to meet the new danger. A moment's consideration sufficed to dismiss the first idea of supplying different-coloured helmets to be donned when gas of a special odour or appearance came over. The odours attributed to gases range from that of "rotten dog-fish" to "fruity port," and one can imagine the perplexed Mr. Atkins waking up at night to the problem of deciding whether he smelt rotten dog-fish and then by matchlight picking his yellow helmet out from his bundle! It was therefore essential that the one helmet should be "polyvalent," and you will understand something of the terrible anxiety of those days when urgent appeals followed each other almost day by day,

while every fresh addition to the absorbent solution raised a myriad difficult problems of incompatibility. The point will be even clearer when I mention that, in all, protection against no less than forty-three different gases was desired in one helmet. But of these I need only specifically mention two that stand out as of dominant interest.

(*a*) Carbonyl chloride was the main difficulty. On account of its being so inert, this one gas found us at our test of the fifty-eighth tried absorbent (not counting modifications) before we found one that was both satisfactory and commercially practicable: other absorbents were found, but, to our intense disappointment, proved to be unprocurable in the necessary amounts. Then, too, its high toxicity made very complete absorption essential. Its delayed action also retarded progress: well I remember the joy with which at 4 a.m. one Sunday morning we first thought we had found success when we had filtered it down to 1 in 40,000, and a rat had survived the hour's test apparently unaffected; nor shall I forget the disappointment when our hopes were shattered by the rat dying forty hours later.

(*b*) Hydrocyanic acid, in spite of its being slightly lighter than air, was a menace because of the large amounts which could be used by the Germans, who had held a practical monopoly of its pre-war manufacture. Its small power of combination, and liability to be again liberated by even so weak an acid as carbonic, made it most difficult to arrest and fix in the helmet, while its high toxicity made the admission of even small quantities dangerous.

At this point it is convenient to slightly anticipate, and mention the lachrymatory (tear) gases which were brought into use in the autumn of 1915. In minute proportions they act on the eyes only, but with such effect that one part per million causes within two or three minutes such a gush of tears that they flow down the face on to the tunic, and so blur the vision that accurate rifle-fire is impossible. When used in shells, the shell-hole was rendered untenable as regards effective defence for twenty-four hours, while shell fragments retaining the least trace affected the eyes even after having been brought from the front to England. No helmet could be expected to remove such minute traces as this, but at first the only trouble that resulted was the necessity of providing goggles to be worn beneath the helmet. Later, however, the concentration in which certain of these lachrymators was used rose to a point at which the lungs were also affected, and a new protection had to be devised.

The extraordinary potency of these later products of fully established gas-warfare can perhaps be best realized from some data worked out by our physiologists. Two standards of comparison were instituted—one being the minimum effective concentration which incapacitates within five minutes, and the other being the maximum concentration which could be endured with safety for an hour. We may take one illustration from each class of gas as follows:—

Examples		"M.E.C."	Maximum safely endurable for an hour
Asphyxiant: Carbonyl chloride		1 in 5,000	1 in 200,000
Paralysant: Hydrocyanic acid		1 in 10,000	1 in 100,000
Lachrymator:— Benzyl Bromide	Eyes	1 in 1,000,000	1 in 10,000,000
	Lung	1 in 100,000	1 in 1,000,000

Research and Personal Tests.—Before proceeding to discuss certain illustrative secondary problems of this work we may consider the general lines upon which

research was conducted, in the effort to find means of protecting our men against gas in such dilutions as these.

Immediately a new gas was considered possibly and probably included among those being prepared by the enemy, it was added to the list regarding which a special reader at the British Museum Library was employed in seeking recorded information. With regard to the toxicity of most, no reliable information was anywhere obtainable; while the total recorded knowledge of the rarer gases was often summed up in two or three lines in some musty tome. The first step was thus to discover some way of making each gas in sufficient amount for testing, and this was undertaken mainly by chemists in the Imperial College of Science and Technology and the University of London Laboratories.

Immediately sufficient gas was available, tests were begun to find a method of quantitative analysis delicate enough to measure such minute amounts as remained when the limits of probable safety had been reached. Thus, before we could begin actual tests of absorbents, initial original researches had to be conducted which in ordinary times of peace would have taken weeks to complete.

Then began the testing, on helmets, of possible absorbents which had meanwhile been thought out and prepared, the efficiency of absorption by which was the subject of most precise estimation.

When an absorbent had been found which gave chemical results that appeared promising on analysis, the gas mixture passing through a treated helmet was led, as already described, into the desiccation chamber containing a rat, and it was seen if the animal survived exposure for the standard period of one hour.

If the rat survived, the test had to be repeated on a larger scale with a pig on which a helmet was secured. And, if the pig also survived, one of the investigators had to don a helmet and remain for an hour exposed to the gas in what was termed the "lethal chamber."

At this point I cannot refrain from a tribute to the gallantry and devotion to duty of the small band of scientists whom I had the honour to have serving under my orders, and I can only make that tribute effective if we pause for a moment to realize what were the conditions in that lethal chamber where so many hours were spent. Everyone had at one time or another been incapacitated by an overdose of the simpler gases, but there was no time to do more than lay the victim on a bed that was kept ready in the laboratory; give oxygen and administer chloroform vapour, and leave an orderly to watch him until he recovered. There were no other means of treatment, for at that time no others had been found, nor opportunity to seek them. But the victim was no sooner on his feet again than he was back at his special work, shaken and ghastly, but resolute. The only difficulty was that of deciding rival claims to undergo the test—as between the discoverer of an apparently effective absorbent and the officer first on the normal roster. In the lethal chamber itself many acrid gases had so corroded the fittings that no light could be turned on, while speed often necessitated the use of a helmet in which there had been no time to fit a window. But beyond the heavily-curtained door there was always a helmeted colleague counting the minutes, and ascertaining by shouts or knocks that the inmate had not collapsed. In the darkness and through the long-drawn-out stress of endurance the minutes slowly passed; first the quarter-hours were called, then the five-minute intervals, and at the last, when it seemed impossible to hold out for the

hour, the passing of each individual minute was notified. Picture the conditions of the ordeal, that so often came in the small hours of the morning, when some test had just matured, and minutes were precious in the fight for the safety of our men at the front, and you will understand something of the pride that we may well feel in the two-in-the-morning courage of these workers.

But there was still more in store when the time came that one of them must take his life in his hands, and himself prove the safety of the latest device against the most deadly of the gases that had to be faced. Just one illustration from carbonyl chloride: The pig had survived for some days after his test; time pressed; the volunteer donned the experimental helmet, and completed the hour's test in the lethal chamber. Next day the pig suddenly died, and its lung was found dotted with the grey patches characteristic of carbonyl chloride poisoning; two days later the volunteer began to expectorate black pellets, and there was a period of tense anxiety as to his fate, until the hand of time slowly wrote a reprieve.

(D) Special Problems of this Stage.

The special problems of this stage may now be dealt with in more detail.

A new solution was made necessary by the fact that the "hypo" and sodium carbonate hitherto used on the helmets afforded no protection whatever against carbonyl chloride and hydrocyanic acid, to say nothing of others on our list of forty-three gases. An effective absorbent for both these and the great majority of gases used against us was found at last in sodium phenate, but before the new "P" helmets (as they were called) were issued in July, 1915, many secondary difficulties had been surmounted.

The first great set-back occurred when it was found that this solution slowly rotted the woollen fabric of which the helmets were then made. That led to experiments to determine the cause and remedy. These showed that woollen helmets can take up 50 grammes of glycerol when impregnated, but that that amount protects the fabric from the rotting action of only 18 grammes of sodium hydroxide; whereas cotton helmets of double thickness can contain and withstand 30 grammes of that corrosive alkali. It was further shown that the double thickness cotton only gave a permeability resistance of 0·2 in. to 0·3 in. of water, as against 0·3 to 0·5 in. for single thickness wool. Although the rotting of wool seemed a disaster at the time, it finally assisted us, in that we were able to get so much more absorbent alkali into the cotton. The phenate may assist absorption, but it was proved that the sodium hydroxide was the essential ingredient.

Another shock was the burning of the arms of over 200 women on the first day on which helmets were dipped in this caustic solution. This was distressing to us as well as them, for they had worked gallantly night and day, and this action was quite unexpected from our short exposure of hands to the new solution. It necessitated special treatment and precautions regarding which the dermatologists gave us their aid.

That brings us to the next urgent problem, which was the reason why rats which for twenty-five minutes had shown no ill-effects from hydrocyanic acid passed through helmets charged with the sodium phenate solution should suddenly die with acute symptoms of paralysis at the end of that period; and why this only occurred when carbon dioxide at human expiration rate accompanied the flow of hydrocyanic acid. Experiment proved that the amount of

carbon dioxide given off by a man at rest was just sufficient to neutralize one gramme of the protective alkali per minute. Therefore, as hydrocyanic acid was arrested and converted into sodium cyanide on the outer layers of the helmet, carbon dioxide was steadily neutralizing layer by layer the thirty grammes of protective alkali on its inner surface. At the end of twenty-five minutes the intervening layer of intact alkali was eaten through, with the result that not only did the poisonous gas from the air mixture outside pass through untouched, but it was greatly increased by the carbon dioxide liberating much that had been arrested and fixed in the outer layers of the helmet during the preceding period of the test.

It thus became obvious that we must provide a valve through which the wearer could expire, and so discharge his carbon dioxide outside the helmet instead of through its texture. Within a few hours of discovery of this most important fact there was invented the simple but most effective valve now shown that still remains in use. When first made straight-cut across it served its purpose, but made such a bleating noise that it was impossible of use in the field. An anxious survey of the physics of this production of sound was rewarded by discovery of the simple device of chipping the corners and joining the intervening tongues of rubber. No seated valve could have been made in the time and numbers required, nor would any have given such effective protection as this simple device. Not only did the introduction of a valve meet the dangers of hydrocyanic acid, but it enabled our men to attack with a vigour impossible for long with the old valveless helmet in which their expired carbon dioxide accumulated so fast when increased by violent exertion.

The need for protection of the eyes against the small but effective amounts of lachrymators which penetrated this phenate helmet made it necessary to evolve some addition to be worn over the eyes and beneath the helmet. Time does not permit of our following the evolution of this additional device through the various stages, so I simply show the rubber goggle that finally proved so effective.

One more addition—made in January, 1916—marks the final improvement in the helmet that gave it an absorption of 100 per cent against 0·1 per cent of both carbonyl chloride and hydrocyanic acid gas for an hour, and brought it to its zenith under the name of the "PH" variety. That was the addition to the solution of hexamine (hexamethylene tetramine) suggested to us from Russia, which removed the remaining 1·2 per cent of carbonyl chloride that eluded the sodium phenate. At one time this substance was being made at the rate of a ton a day for our purposes.

Of these helmets, from the first issue in July, 1915, until they were finally withdrawn in February, 1918, in favour of the small-box respirator as the sole issue, no less than 26,800,000 were made—involving the use of some 880,000 gallons of solution. Some interesting photographs are on exhibition to-night showing something of the commercial organization required to produce an output which rose to as high as 108,000 helmets in one day, involving the discharge of a packing-case a minute throughout the twenty-four hours.

Many were supplied to our various Allies as well as those sent to our own troops, and it is obvious that they played a very important part among the

accessory factors which enabled us to emerge from the war with victory crowning our efforts.

Not only did they protect our men, but they were used to protect the horses also. This is something to set against the memory of the mental distress of watching the unfortunate animals which had to be sacrificed to the stern necessities of our troops. If intensity of feeling could speed their flight to some responsive Power, our anathemas on the enemy who made those tests imperative must have sped far and fast.

Every tragedy has its lighter side. One letter of thanks was received from a mess which had celebrated its Christmas on roast pork, but only as a result of detailing one of its members to sit up all night and hold a helmet over the head of the pig—which showed a lamentably unappreciative spirit—during a prolonged gas attack on December 22.

(E) Advent of the Box-respirator.

It must be realized that no helmet could ever be completely "polyvalent," if only because of the impossibility of impregnating so thin a layer of textile with both oxidizing and reducing substances. The final helmet, therefore, failed to keep out certain gases, most important among which were arsine and some lachrymators—especially chlorpicrin, which resisted the otherwise effective sodium ricinate.

As early as July of 1915 it was realized that this would eventually prove to be the case, and experiments were commenced with a view to production of a "tower" containing strata of different absorbents through which the inspired air could be drawn so that each group of gas would be removed by its appropriate absorbent. As early as August success was obtained in the laboratory both with long canvas cylinders containing recently activated charcoal and with smaller metal towers filled with specially made granules. It is as well that these experiments were begun betimes, for the final success over difficulties of granule production was only obtained in time to enable the "box-respirator" to be issued in February, 1916, when the art of gas-warfare, with the notable exception of "mustard-gas," had reached its zenith. It was then in readiness to meet the development by which lachrymators were used in amounts which would pass through the helmet and attack the lung, and was issued only one month before the enemy attacked with gases which the helmets could not have withstood.

We may now consider the special problems concerned in the production of the "box-respirator," containing separated layers by which gases were removed either chemically or physically.

Against arsine nothing was found so practically effective as soda-lime-permanganate, with its wide "polyvalent" action, but the granules of this substance were so friable that after slight shaking of the container they broke down into fine dust, which entered the air passages and set up such violent coughing that the apparatus had to be removed by the wearer. It was a comparatively easy matter to harden the granules by sodium silicate or calcium sulphate, but when this was done they were found to be inactive. In the effort to strike the mean, and obtain an active but moderately hard granule, Lieut.-Colonel E. F. Harrison—whose memory we all honour as that of a superlative worker who gave his life for

the cause—reached his forty-ninth laborious serial attempt before he succeeded, after infinite patience and resource, in making up a satisfactory product.

Against chlorpicrin in high concentrations—as a combined asphyxiant and lachrymator—sodium sulphite was found necessary at first, but later an increase in animal charcoal was found to remove amounts which the enemy were capable of using.

The box-respirator was originally charged with successive layers of sodium sulphite (reducing), soda-lime manganate (neutralizing and oxidizing), and animal charcoal (condensing and absorbing), the layers being separated by plaques of cellulose. This was found to be completely "polyvalent" against every gas which the enemy had then used against us, and to give such slight resistance to respiration that it allowed three cubic feet of air to pass per minute at a suction pressure of only 0·2 inch of water, so that the user was capable of vigorous exertion. The duration of efficiency was three hours against carbonyl chloride, and as long as eight hours against chlorine, while the box withstood a sequence of six gases run through it in succession, each for an hour.

But our troubles were not yet at an end, for it was found that gas tended to pass up along the smooth interior of the box, where it was only exposed to absorption on the one side, with the result that this channel became denuded of its absorbent while the main bulk of the contents remained untouched. This was only determined when a glass box was made resembling the metal container; filled with granules moistened with mercurous chloride solution; and the course of the gas followed by the darkening along its path. Remedy was found by corrugating the sides of the box to lengthen this route; leaving large air-spaces above and below the absorbent layers, to equalize the flow; and by arching the base of the lowest absorbent layer so as to divert the flow from the sides. Uniform darkening then showed that the flow of gas was evenly distributed.

It was next necessary to provide a separate exit for expired air, to prevent carbon dioxide from accumulating in the chamber, where it would neutralize the soda-lime alkali. This made two valves essential, the familiar expiratory rubber type in the connecting tube near the wearer's mouth, and the other an inspiratory flap-valve at the base of the box.

Eyeglasses and a mouthpiece were incorporated in a tightly-fitting face mask —as demonstrated—a metal clip for the nostrils being added. Although apparently complex, the apparatus was adjustable in twenty-five seconds.

This was the form taken by our means of protection to the end of the war, although slight modifications were made which led up to the "small box-respirator," of which 16,000,000 were issued, bringing the total of protective devices made up to 55,000,000.

That sets the limit to my endeavour to give you, in the time at my disposal, an insight into the work involved and the methods employed in the task set by the onset and evolution of gas-warfare. Of some branches of the work, e.g., that of the physiologists, I have said nothing; of the invaluable services of the expert advisers, who stood ever ready at call and need, I have been able to say but little; of the huge labours and successful organization of the manufacturers I hope you will glean some notion from the photographs shown to-night.

But amid the terrible stress and anxiety of those days and nights of ceaseless strain, many a willing worker flitted across the stage and passed again into the

shadows without our ever having time to give him more than a mere word of thanks. As these reminiscences have recalled many a half-forgotten scene, these personalities among the crowding memories have emerged from the shadows into the limelight one by one, and the sense of gratitude has surged upwards anew.

To those among my audience who aided us in the Service by the whole weight of their scientific knowledge and technical experience, our thanks go out in no meagre measure, and there are none among your staff who have not earned the deep gratitude of each of us for timely and invaluable help in many branches —in chemistry, physics and metallurgy, to my personal knowledge. It is to such splendid institutions as this that the nation looked in its hour of scientific need, and did not look in vain; and it is to such institutions as this that, with an ever-increasing appeal, we shall have to look for victory in the future strife of industrial competition, that can only be won by superior technical skill.

That we need such a practical grasp as your training gives was brought home to us by many a fatuous suggestion for dealing with the problems that we have just been discussing. One example is perhaps a sufficient illustration of the impracticable suggestions by which we were harried at the time of severest stress. Each man was to have a mask fitted to a long, pointed steel tube. When the gas came over, the wearer, like a gigantic biting fly with a proboscis, was to thrust his snout deep into the earth and breathe through it pure air from the depths. One among the myriad practical objections is enough, and it reminds one of the method advised by Mark Twain for scaring an aggressive dog. He says that you should bend down, throw your coat over your head, and advance upon the dog backwards. I imagine that, as the enemy swarmed to the bayonet attack following the gas, and found the defenders bent double over the tubes that they dare not remove their mouths from, they would feel much the same fierce joy as the dog referred to above.

In conclusion, there is one aspect which, as it does not personally concern me, I can speak my mind upon freely, and not spare the blushes of the chemists and physicists present.

In their blatant self-complacency the Germans had so long vaunted the supremacy of their scientists in these branches, that the world had begun to accept them at their own valuation. When, therefore, their equally over-rated army failed to win the anticipated victory by fair means, they summoned their acclaimed supermen, amid secret rejoicings that now they were going to win because of what one authority termed the "better brains" that they possessed. So their scientists came off their pedestals, and put no limit to their further descent as they got to work, in the hope that the surprise of this blow below the belt would settle us. The Hun watched their advent with secret exultation, and one can hear the whispered chorus almost in the words of old Nokomis:—

He, the mightiest magician,
Sends the pestilential vapour,
Sends the poisonous exhalation.

What was the result? When once the first incredulous surprise was over, and we had mobilized our scientists to combat theirs, the result was never again in doubt. Our scientists won at every turn and twist in the sordid conflict that they had forced upon us, until at last the nation that had elected to fight a foul

war—beaten and cringing—appealed through Switzerland in February, 1918, that the methods which they had adopted with such gloating eagerness should be abandoned by mutual consent.

I think it was Marmion who cried with his last breath:—

> Curse on yon base marauder's hand,
> But double curse my failing brand.

And among all the curses that lit upon the heads of those Germans who were responsible for the adoption of gas-warfare and all its fiendish tortures, I can imagine none more virulent than those of their own men who, with their belief in the supremacy of their scientists shattered, died in protracted agony as the result of imperfect protection in the gas-warfare they had invoked.

Current Literature.

The German Official Medical History of the War.—The forthcoming issue of the German Official Medical History of the War has lately been announced. The work has been planned on a scale commensurate with the importance of the subject, and will consist of nine volumes, of which the prospectus gives details.

Vols. I and II will deal with military surgery (Editors Professor Erwin Payr and Professor Carl Franz). They are divided into a general section of five subsections, and a special section of fifteen subsections, each subsection being entrusted to authors identified with the subject. To these two volumes are allotted 1,500 pages. The first will be published in the later months of this year. The remaining volumes are as follows:—

III. Internal Medicine (Editor Professor Ludolph Krehl). 900 pages.

IV. Nervous and Mental Diseases (Editor Professor Karl Bonhoeffer). 500 pages.

V. Ophthalmology (Editor Professor M. Axenfeld). 600 pages.

VI. Wounds and Diseases of the Upper Air Passages and Digestive Tract and of the Ear (Editors Professor Gustav Killian and Professor Otto Voss). 300 pages.

VII. Hygiene (Professor W. Hoffmann and Professor K. Kutscher). 500 pages.

VIII. Pathological Anatomy (Professor Ludwig Aschoff). 600 pages.

IX. Röntgenology (Editor Professor Rud. Grashey). 450 pages.

The above will give a sufficient idea of the scope of the work. Each of the volumes is contributed to by a numerous body of writers chosen with care for their special knowledge. We may therefore anticipate that the History will give a comprehensive, authoritative and balanced survey of the scientific work carried out by the German Medical Service in the heavy task laid on its shoulders during more than four years of intense warfare. It will be noted that the History deals only with professional and technical subjects.

One point which may cause some surprise is the proportionately small space allotted to hygiene; but a glance over the schedule will show that most of the prophylactic work is dealt with in other volumes under the headings devoted to special diseases. That the influence of preventive medicine had not been fully grasped by the German military authorities at the inception of the war, looking as they confidently did to a short victorious campaign, must be admitted; hence

their experience of typhoid fever in the early stages. But their Medical Service was not slow in noting deficiencies nor in supplying the necessary correctives, and the subsequent general health of the armies in the field is sufficient evidence of energy and efficiency on its part.

We naturally heard little of the German Medical Service during hostilities; but what we have heard since shows that by hard and successful work they acquired and retained the confidence of their own soldiers. Ludendorff in the few references he makes to them in the course of his Memoirs is always outspoken as to their efficiency.

The published prospectus of the official history contains the "Introduction," by Lieutenant-General Otto von Schjerning, Director-General of the Medical Service of the German Army; a document of more than ordinary interest. It is evidently written under a sense of keen disappointment at the result of the war, but it is penned with restraint and dignity and both in language and scope is noteworthy.

"It (the war) has compelled us to see ourselves and to deal with ourselves as we really are; to smite our breasts and to discard the high buskins on which we strode about the stage in such an unjustifiable manner; only thus can we see ourselves and our own work in its true light." . . . "So we now find ourselves more receptive and more inclined to a critical matter-of-fact judgment of the phases of progress which the war has brought to us."

He defines the object of the history as to set forth "every new achievement which has been made by our physicians in the science and art of medicine during the war period." The Introduction touches on these new achievements. The field is large and the survey is wide and comprehensive.

The writer pays a high tribute to his medical officers and to the admirable manner in which they carried out their heavy duties. Their devotion is best attested by their heavy losses.

One thousand three hundred and twenty-five gave their lives: "that is 54·2 per 1,000 of the total strength and of these 562 or 23 per 1,000 fell in battle or died of wounds and 763 or 31·2 per 1,000 succumbed to disease; 2,149 were wounded and 467 are missing." On such a record the German Medical Service may well look back with pride.

In the first period of the war, during the fevered onrush into Belgium and France, up to the battle of the Marne, the German system of dealing with casualties was one of almost complete evacuation to the home territory. "The rule was that only those were left behind who could not be transported or whose wounds could be healed in a very short time. All the rest went by the 238 hospital trains into Germany." With such a large number of hospital trains it is a matter for regret that room could not be found in them also for the wounded prisoners who fell into the German hands at that period.

With the onset of trench warfare the number of wounded increased largely, shell wounds predominating, and tetanus made its appearance; only, however, to be soon subjugated by the free use of anti-tetanic serum as a prophylactic. For his services in this connexion, Behring was decorated with the Iron Cross at von Schjerning's instance. Typhoid fever and dysentery are also noted as occurring on the Western front at this time.

On the Eastern front typhoid fever, dysentery, and then typhus taxed the resources of the Medical Service, and with the summer of 1915 cholera was added. These were combated by vigorous general hygienic measures supplemented by special prophylactic sera and vaccines. To the cholera and anti-typhoid inoculations much success is attributed; but as to the value of the special inoculations against dysentery and typhus opinions are divided. It will be interesting to learn more of the special characters of these measures in the section dealing with them in this history. So great was the fear of introducing

typhus and dysentery into the home country that "it was ruled and made compulsory that no convalescent from typhus or dysentery should be invalided home to Germany. "Convalescents from those diseases on the West were collected at Spa and there retained until they were ready to rejoin their regiments."

In the East an elaborate chain of eighteen cleansing stations was established, capable of dealing with a total of 100,000 men and their effects in a day, and no man was allowed to travel westwards without passing through one of these stations. In this way the filtration of disease into the home territory or to other fronts from the East was prevented.

In 1916 gas gangrene was particularly prevalent around Verdun and continued to claim victims almost up to the end of the war, more especially in the Somme offensive and in the region of the Aisne. A special intensive study was made of this disease, and the experiments carried out "resulted in a mode of treatment which unfortunately only reached in the last period of the war the perfection that might result in perfect cure." "The Subsection on Wound Infections, its Prevalence and Treatment," by Prof. A. Lawen and Prof. George Schone in the first volume of the history will be awaited with interest for further light on this point.

Allusion is made to the heavy incidence of frostbite, especially in the waterlogged trenches in Flanders, and to what is called the "five-day fever of Volhynia," first noticed in the East but brought West by transferred troops; to scurvy which affected the troops in Roumania; to trench nephritis East and West; and to the increasing prevalence of malarial affections in their varied forms as more men became engaged south of the Danube. In the German army the battle of quinine prophylaxis has also been fought, and the conclusions arrived at will be of value to compare with our own.

In 1918 it is noted as a new phenomenon that paratyphoid became severe in the West, especially in Flanders; whilst in the Aisne district spirochætal jaundice prevailed. Towards the end of the war the great influenza pandemic, accompanied by a fatal form of pneumonia, laid a heavy toll on the troops; and skin diseases, especially tinea of an intractable type, became an increasing infliction.

With regard to venereal disease there was always a full proportion, the chief centres being Brussels, Warsaw, and Bukarest, but treatment was well abreast and relatively the incidence in the home territory was greater than that with the troops in the field.

A brief mention is made of injuries from aeroplone bombs, in which it is incidentally stated that many medical officers were killed in this way, some in the performance of their hospital duties.

Poison gas attacks appear to have recoiled with disastrous results on their originators. "The attacks by poisonous gases were particularly destructive; this mode of warfare was entirely new and had to be brought to the comprehension of physicians by special courses on the treatment and healing of gassed soldiers, and on the prevention of gassing by means of gas masks."

The war being fought on foreign territory, the building of vast hospitals became a necessity, and medical officers are praised for the skill which they acquired in laying out and equipping these units in a manner to fulfil all hygienic requirements. Special stress is laid on the bathing and disinfecting plants and delousing stations. The importance of these last named impressed itself forcibly on the Higher Command, and Ludendorff mentions in his book the great inconvenience caused by the loss of some of these stations in the early stage of the last Allied offensive.

The provision of hospitals for special disabilities was developed as the war proceeded and is mentioned with approval.

On an average there were more than 24,000 medical officers serving the Army, of whom two-thirds were with the troops in the field. There were in addition

600 dentists and 1,800 apothecaries. Towards the end of the war the losses became so high that vacancies could only be filled by calling up medical students for duty.

The writer refers to the great advantages which accrued to medical men engaged from their co-operative work and interchange of ideas; also to the great Congresses which were held at intervals at Brussels, Berlin, Cologne and Warsaw, where knowledge was focused and disseminated.

As proof of advancing efficiency the following figures are given of the proportion of men returned as "fit for duty" from hospitals during successive periods: 88·7 per cent in the first year of the war; 91·3 per cent during the second year of the war; 91·8 per cent in the third year; 92·8 per cent in fourth year.

Some allowance must be made for the varying standard of "fit for duty" in the different periods; but even so, the figures are a remarkable testimony to the success of the Medical Service in preventing depletion of the ranks. The Adjutant-General was well served.

To indicate the success of the Medical Service in its hygienic efforts it is pointed out that ten times as many men were killed in battle as died of disease, the respective figures being 1,531,048 and 155,013. The number of wounded amounted to 4,211,469. The incidence of sickness per 1,000 of strength for the successive years is given as: "First year 1,530; second year 1,188·5; third year 1,010·8; fourth year 1,005·6. These figures show a progressive improvement, vitiated only in the last year by the influenza epidemic. In the four years of war the total number of sick amounted to 19,461,264. Of the different groups making up this total the largest is that from wound casualties; the second from tonsillitis and diseases of the stomach and intestines; whilst infectious diseases gave only a moderate total, of which influenza accounts for 706,308.

Venereal diseases in the first year were responsible for 15·2 per 1,000 of the total strength and rose to 20·2 per 1,000 in the last year. Tuberculosis, the mortality from which rose in the populous cities in the homeland by the large figure of 85 per cent during the war, showed an actual diminution in the field armies. The figures given are: 7,166 tuberculous cases, or 2·8 per 1,000 in the first year; 6,865 cases in the second year; 5,520 or 1·1 per 1,000 in the third year, and 3,929 or 0·78 per 1,000 in the fourth year, notwithstanding that in the last year the men were of poorer physique, and many called up had already been treated in tuberculosis hospitals. This result is attributed to the progressive hardening of the soldiers from constant exercise and life in the open air.

The most brilliant scientific discoveries are said to have been made in the field of medical ætiology. The elucidation of the part played by the louse in the spread of typhus fever is claimed, and is stated to have had far-reaching results. Thus "before this knowledge hundreds of deaths took place from this disease in our prison camps, which had been invaded by typhus; but after the vermin had been generally destroyed the disease disappeared entirely." Claims are also made for the discovery of the nature of "five-day fever" and of the spirochæte as the special cause of Weil's disease. Important researches into causation of trench nephritis, paratyphoid infections, and the various forms of malarial fevers are enumerated, as well as into the factors underlying wound infections, gas gangrene and hunger œdema amongst other subjects.

In the field of diagnosis mention is made of the extension of the use of X-rays, of the exploration by means of microscopic and cultural methods of the bacteriology of the dysenteries; of the early demonstration of the spirochæte in the identification of syphilis and of further developments in the recognizing of malarial and relapsing fevers.

Results obtained with preventive inoculations against infectious diseases such as typhoid fever, dysentery, cholera, and paratyphoid, as well as against tetanus, are

described as "path-breaking." All this does not sound very novel, as similar knowledge had long been made available by allied observers some years before the war, but the detailed monographs must be awaited to see how far our sum of knowledge in these matters is said to be added to. For the present it would seem that in some cases independent observers working at similar problems have arrived at similar results, and that successful research is not a monopoly.

In the domain of medicine conspicuous advances are alluded to in the treatment of neuroses, whilst the recovery from typhoid fever and dysentery is said to have been hastened by the giving of a liberal diet at the beginning of the second week, as opposed to the old starvation treatment.

In surgery, amongst many advances, the most outstanding is pronounced to be in plastic work, more especially about the face. Great attention was paid to pathological anatomy. Post-mortem stations were established in all the armies under the direction of the Pathologist attached to the Chief Surgeon, and investigations were carried out on definite lines. Nor were these confined to pathological conditions; but advantage was taken of the unexampled wealth of material to examine many points of anatomical importance, and "to make most valuable observations of the normal conditions of the organs in human bodies still warm in life."

In conclusion, Lieutenant-General von Schjerning expresses the hope that the history will be a lasting memorial to the medical officers, and will serve to establish their glory and the success of their endeavours. As Chief of the Medical Corps in the war, at home and in the war zone, he thanks them for their willing and self-sacrificing labour, and for the true loyalty to the Corps, and trusts that his country will never forget what they have faithfully and devotedly done for it in the darkest days of the war.

As appendices to Lieutenant-General von Schjerning's Introduction, six tables are given showing in detail the strength and losses of the Medical Corps and the losses, incidence of disease and admissions to hospital of the Field Army throughout the war. For these notes I have freely drawn on a translation of Lieutenant-General von Schjerning's Introduction by Lieutenant-Colonel F. H. Garrison, M.C., U.S.A., published in the April number of the *Military Surgeon*.

M. W. R.

Reviews.

THE EPIDEMICS OF MAURITIUS, WITH A DESCRIPTIVE AND HISTORICAL ACCOUNT OF THE ISLAND. By Daniel E. Anderson, M.D.Lond. and Paris, B.M., B.Sc.Lond., F.R.S.E., F.R.G.S., ex-Laureate of the Royal College of Mauritius. With maps and other illustrations. London: H. K. Lewis and Co., Ltd., 1918. Pp. xii and 312. Price 16s. net.

This book was originally written in 1911 as a thesis for the degree of Doctor of Medicine in the London University, by the author, who was himself born and educated in Mauritius, and, after being qualified in medicine in London and Paris, returned to the island for a time. In response to repeated requests that the work should be published, and having obtained permission to do so from the London University, Dr. Anderson added two chapters on the Geography, Industries and History of Mauritius, which materially added to the interest of the work.

Chapter I gives a general description of the island, its commerce and industries, which is followed by chapters on the sugar cane in the West Indies, the evolution of the Crown Colony, sanitation, and an interesting chapter of reminiscences concerning distinguished Mauritians or residents on the island.

Among the latter was Sir Walter Besant, the novelist, who was for some five or six years a Professor at the Royal College, and of whom some good stories are told. Sir Walter Besant, in addition to his skill as a novelist, was a man of unusually wide general knowledge, a good mathematician and an excellent classical scholar.

In succeeding chapters, various diseases which are endemic in the island, or have visited it in epidemic form, are dealt with, including cholera, small-pox, leprosy and malaria.

The first-named disease visited Mauritius on six occasions in epidemic form between the years 1775 and 1862, and, in view of our present knowledge of the etiology of the disease, it is instructive to note the old views on etiology and treatment as evidenced in official reports quoted by the author.

In the chapter on Small-pox, the experience of the capital of the island, Port Louis, during an epidemic of this disease, affords a good example of the value of vaccination. Malaria is dealt with very fully, and due acknowledgment is made of Sir Ronald Ross's report on "Prevention of Malarial Fever in Mauritius, 1908." Malaria was not known to exist in Mauritius before the year 1865, when it was probably introduced by Indian coolies.

Dr. Anderson's book is purposely written in popular style, so that it should prove interesting to others besides medical men.

We can commend this little book as containing much useful and interesting information, not only on the epidemics of Mauritius, but on a variety of other subjects in connexion with the island, which render it worthy of perusal by all those interested in Mauritius and its history, or who go there either on pleasure or duty. There is a good preface by Professor W. J. Simpson.

O. L. R.

"Psychoses of the War." By H. C. Marr. Oxford Medical Publications. London: Henry Frowde, and Hodder and Stoughton, 1919. Pp. xiii and 292. Price 16s. net.

This book is to be regarded as a treatise on mental diseases in general illustrated by cases occurring during the War rather than an investigation of the mental diseases in whose causation War and its circumstances have played an essential part. Its scope covers not only the psychoses but also the psychoneuroses, the latter being dealt with at considerable length.

The case descriptions are full and clear, and there are numerous excellent illustrations. At the end of the book is a noteworthy scheme of case taking, which includes not only the usual headings and directions for recording the various signs and symptoms present, but also anatomical illustrations and diagrams, so that the student during his examination has constantly before him the data necessary for the interpretation of his observations.

The general plan of the book is, however, open to serious criticism. The classification adopted and the author's conceptions of the nature and etiology of mental diseases is extremely unorthodox and yet it is set forth in a way which gives no hint to the unwary reader that he is being introduced to theories which are not part of the generally accepted structure of psychiatry. Neurasthenia, for example, is divided into simple, toxic or hysterical, and organic. Hysteria is identified into the second of these sub-groups, and is stated to be essentially a simple neurasthenia complicated by a toxic or toxæmic condition of the blood. These views are so opposed to those generally held, that it should surely be incumbent on the author either to detail fully the investigations on which they are based or to refer to other published work in which they have been reasonably established.

The psychological phenomena met with in the various psychoses are interpreted by means of a development of Flechsig's theory of association centres,

and modern psychological methods of investigation and treatment receive but scant recognition.

The book will be of considerable interest to readers whose knowledge of the subject is sufficient to enable them to discriminate between generally accepted views and those which are peculiar to the author, but for the reasons given above it cannot be recommended to the inexperienced student.

VENEREAL DISEASE: ITS PREVENTION, SYMPTOMS AND TREATMENT. By Hugh Wansey Bayly, M.C. London: J. and A. Churchill, 1920. Pp. viii and 152. Price 10s. 6d. net.

This book is written in a simple and straightforward style. It does not claim to originality, but places the essentials for the diagnosis and treatment of venereal disease in a clear manner before the student and the general practitioner.

It seems a pity that the technique of mixing and giving "606" preparations is not described. The 0·9 and 1·0 grm. doses of "914" are unnecessarily large and certainly increase the risk of complications.

The author apparently does not believe in the intramuscular injections of "914," and does not appear to have tried the guaiacol glucose and water mixture, which is very nearly painless.

The author is opposed to posterior irrigations in the early treatment of gonorrhœa; with the irrigating fluid not more than five feet above the man's penis, there is no more risk of complications than with the anterior irrigation and it is much more effective.

The lumbar puncture needle recommended is rather a clumsy instrument: a fine iridio-platinum needle, with handle-grip, is better in every way.

It would be well to put °F. after the temperatures, as is rarely done in the book.

Most of the illustrations are crude and might be better omitted.

The attempt to condense the essentials of the prevention, symptoms and treatment of venereal disease is not an easy task; but we can recommend this small volume to the student and the general practitioner who have neither the time nor the opportunity to devote many of their busy hours to the study of venereal disease.

ANÆSTHETICS. By J. Stuart Ross, M.B., Ch.B., F.R.C.S.E. Edinburgh: E. and S. Livingstone, 1919. Pp. vi and 416.

This little work should prove of great use to students and practitioners. It puts forward the theory of modern anæsthetics clearly and concisely, and the chapter dealing with the administration of nitrous oxide gas will be found particularly useful. The description of the different forms of gas-oxygen apparatus is somewhat limited, but, as the author remarks, there are so many different machines on the market. It would be advantageous if one of these machines became the standard, and hospitals induced to provide the apparatus. All students would then be taught the method of administering this form of anæsthesia.

Chapter XVII on the Sequelæ of Anæsthesia is both interesting and useful.

Many facts not found in larger works on anæsthetics are recorded. For example, the fact that morphia is not a desirable drug to administer before a chloroform anæsthesia, and that the development of laryngeal stridor occurs more often in cases to which it has been given prior to the anæsthetic.

There are a few typographical errors: "vaso-constr*uc*tion" on p. 17 and "peristal*tic*" for peristalsis on p. 141.

The book has much to recommend it and should be of value to young anæsthetists.

THE EARLY DIAGNOSIS OF TUBERCLE. By Clive Riviere, M.D., F.R.C.P., Physician to the City of London Hospital for Diseases of the Chest, Victoria Park, and the East London Hospital for Children, Shadwell, E. Second Edition. London, 1919: Henry Frowde, Oxford University Press, and Hodder and Stoughton. Pp. xii + 314. Price 10s. 6d. net.

The present issue is the second edition of Dr. Riviere's book, the first edition having been published in 1914. The book has undergone extensive revision, particularly in the section devoted to physical signs in adults and children, which has been almost entirely rewritten.

Considerable additions have also been made, including a detailed description of hilus tuberculosis in adults, based on the author's observation of this important condition. The section on clinical diagnosis in adults follows the Introduction, as in the first edition. Physical signs and methods of examination are there dealt with in detail, together with the conclusions to be drawn from them. A description is also given of the author's sign of pulmonary tuberculosis, which he has named the "reflex bands of dullness," a sign which is met with at the apex and lower scapular regions on gentle percussion of the back, and which appears to be a valuable aid to diagnosis, particularly in the earlier stages of the disease. The whole of this section on clinical diagnosis will repay careful study. The new section dealing with hilus tuberculosis in the adult is of great interest, and gives a good account of this not uncommon but frequently unrecognized affection.

The advantages and limitations of X-ray examinations as an aid to diagnosis are next briefly but adequately dealt with.

The value of any particular tuberculin test is now no longer a matter of opinion, but one of ascertained fact, and in the section on "Tuberculin in Diagnosis," which follows, the author clearly sets forth the evidence by which the worth of each method may be estimated, the appropriate methods to employ, and the conclusions to be drawn from the results of the tests.

Further sections deal with the temperature in diagnosis, the sputum, the anti-inoculation test and complement fixation.

The latter part of the book is devoted to tuberculosis in children, which, although very commonly commencing, as in adults, in the lung area, tends to run a different course, and presents a different clinical picture. The clinical diagnosis, including the physical signs, is dealt with, and the general aspect of tuberculosis in children at school age, below this age, and in infancy, is also touched on.

The value of special aids, such as X-rays and tuberculin, is also considered in their applicability to diagnosis in children.

The formation of a Ministry of Health will, it is hoped, result in increased attention being given to the all-important questions of the prevention of tuberculosis and its early detection in those cases in which infection has already occurred.

The early detection of tubercle is so important, both from a national and the patient's point of view, that not only tuberculosis and school medical officers, but all practitioners, both civil and in the Services, should be acquainted with the most recent knowledge on the subject.

We can recommend Dr. Riviere's book as an excellent means of acquiring this knowledge; it is pleasantly and clearly written, and the standing and experience of the author render it a valuable addition to the literature of the subject.

O. L. R.

Correspondence.

A FALLACY IN DYSENTERY STATISTICS FREQUENTLY OVERLOOKED.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—A paper by Woodcock in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS for February, 1920, in which he expresses it as his opinion that Manson-Bahr's figures for the incidence of amœbic dysentery in the Egyptian Expeditionary Force are too low, has again called my attention to a factor which is often neglected when an attempt is being made to estimate the relative proportions of the two forms of dysentery—amœbic and bacillary.

A fallacy is constantly arising from the difference between the two types. In bacillary dysentery it is well known that the chances of isolating the organism diminish rapidly after the first two days of the disease, while frequently the blood and mucus disappear also. In amœbic dysentery, though acute symptoms may vanish, the organism still persists, especially after inadequate emetine treatment, even after a full course of the drug.

Now, the custom in an army is to evacuate towards the base hospitals all cases of dysentery, and this process, with the intervening field ambulance and casualty clearing station, takes, as a rule, several days. If 100 cases are thus sent down the line, by the time they have arrived at the base a large proportion of the bacillary cases have ceased to be recognizable as bacillary dysentery, and the chance of isolating the organism is practically *nil*, while the amœbic cases, even if not showing actual blood and mucus dysentery, will still be harbouring recognizable *E. histolytica*. If only clinical appearance or positive isolation of organisms is taken into account, and the history of blood and mucus, often very vague, is neglected at the base, it must happen that the estimate of the amœbic infections will be too high.

Two striking illustrations of this have occurred during the war. The great outbreak of dysentery at Gallipoli was regarded chiefly as amœbic, because amœbæ were said to have been observed in Egypt among the Gallipoli dysenterics more frequently than bacilli were isolated. The reason for this is largely due to the fact that by the time the bacteriological examination was made in Egypt the chances of isolating the organism had greatly diminished.

The second instance occurred when I visited India and Mesopotamia with the Medical Advisory Committee in 1916. The Mesopotamian dysenterics were evacuated to India, and examinations made there naturally resulted, for the reason explained above, in the isolation of bacilli from only a few of the original bacillary dysentery cases and the discovery of *E. histolytica* in a large proportion of those who suffered from this infection in Mesopotamia. The opinion was formed in India that the dysentery of Mesopotamia was chiefly amœbic. On arrival in Mesopotamia, it was soon quite clear, as was expected from the Egyptian experience, that the bulk of the dysentery was bacillary in nature.

It thus appears that with the concentration of dysenterics at the base, there is a tendency to overestimate the amount of amœbic infections and underestimate the bacillary ones.

I think this factor is of sufficient importance to be taken into account by all those who are dealing with the complicated question of the dysenteric statistics of the war.

I am, etc.

C. M. WENYON.

Wellcome Bureau of Scientific Research,
25, 26 *and* 27, *Endsleigh Gardens,*
Gordon Square, N.W.

May 6, 1920.

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C.N. = Clinical and other Notes.
C.L. = Current Literature.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

JANUARY, 1920.

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
November 26, 1919.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign.

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF THE BELGIANS.

Croix de Guerre.

Temp. Capt. (Acting Major) Douglas Edward Crosbie, M.C., Royal Army Medical Corps.
Qmr. and Capt. William Henry Russell, Royal Army Medical Corps (Territorial Force).

DECORATIONS CONFERRED BY HIS HIGHNESS THE SULTAN OF EGYPT.

Order of the Nile.

3rd Class.—Temp. Capt. (Acting Lieut.-Col.) William Angus, M.D., Royal Army Medical Corps; Lieut.-Col. and Brevet Col. (Temp. Col.) Walter Holland Ogilvie, C.M.G., M.B., Indian Medical Service.

4th Class.—Capt. Charles Henry Allen, O.B.E., M.B., F.R.C.S., Royal Army Medical Corps (Territorial Force); Major Dodington George Richard Shurton Baker, Indian Medical Service; Capt. Hubert Horan Brown, Indian Medical Service: Temp. Capt. Roland Hurst Hadfield, Royal Army Medical Corps; Temp. Capt. William Noel Montgomery, M.B., Royal Army Medical Corps; Major Samuel Hubert Seccombe, Australian Army Medical Corps.

DECORATIONS CONFERRED BY THE PRESIDENT OF THE FRENCH REPUBLIC.

Légion d'Honneur.

Officier.—Major-Gen. Sir Thomas Yarr, K.C.M.G., C.B., F.R.C.S.I., Army Medical Service.

Chevalier.—Capt. (Acting Lieut.-Col.) Duncan Campbell Lloyd Fitzwilliams, M.D., F.R.C.S., Royal Army Medical Corps (Territorital Force); Temp. Capt. Alan Edward Staffurth, Royal Army Medical Corps.

Croix de Guerre.

Temp. Capt. Oscar Glennie Donovan, Canadian Army Medical Corps.

Médaille d'Honneur avec Glaives (en Bronze).

128133 Pte. Maurice Hunt, Royal Army Medical Corps (Liverpool).

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF THE HELLENES.

Medal for Military Merit.

3rd Class.—Capt. James Rowland Hill, M.B., Royal Army Medical Corps; Major (Acting Lieut.-Col.) Osburne Ievers, D.S.O., M.B., Royal Army Medical Corps; Lieut.-Col. Montagu Marmion Lowsley, D.S.O., Royal Army Medical Corps: Lieut.-Col. and Brevet Col. (Temp. Col.)

William Henry Snyder Nickerson, V.C., C.M.G., M.B., Royal Army Medical Corps; Capt. John Patrick, M.B., F.R.C.S., Royal Army Medical Corps (Territorial Force); Temp. Capt. (Acting Major) William Halliday Welsh, M.D., Royal Army Medical Corps; Qmr. and Capt. Henry Williams, Royal Army Medical Corps.

4th Class.—Temp. Capt. James Connor Maxwell Bailey, O.B.E., M.D., Royal Army Medical Corps.

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF SERBIA.

Samaritan Cross.

26142 Serjt. Alfred Lewis Hencken, 33rd Stationary Hospital, Royal Army Medical Corps (Tottenham).

War Office,
November 29, 1919.

AMENDMENTS.

The following is the correct description of the officer awarded the Military Cross in the *London Gazette*, dated March 8, 1919:—

Temp. Capt. John Sawers Clark, M.B., Royal Army Medical Corps, attached 15th Battalion Royal Irish Rifles.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W. 1,
December 12, 1919.

The King has been graciously pleased to give orders for the following promotions in and appointments to the Most Excellent Order of the British Empire, in recognition of valuable services rendered in connexion with Military Operations in France and Flanders. To be dated June 3, 1919:—

To be a Commander of the Military Division of the said Most Excellent Order:—

Temp. Lieut.-Col. Charles Samuel Myers, M.D., Royal Army Medical Corps.

To be Officers of the Military Division of the said Most Excellent Order:—

Major John Herbert Curley, Royal Army Medical Corps.

Capt. (Acting Lieut.-Col.) Oswald William McSheehy, D.S.O., Royal Army Medical Corps.

Capt. Charles Sefton O'Neill, M.D., Royal Army Medical Corps.

Capt. (Acting Lieut.-Col.) Henry Charles Deans Rankin, M.B., Royal Army Medical Corps.

Capt. Robert Williamson Asher Salmond, M.D., Royal Army Medical Corps (Territorial Force).

Capt. Donald Charles Scott, Royal Army Medical Corps.

Major (Acting Lieut.-Col.) Harry Christopher Sidgwick, Royal Army Medical Corps.

Capt. (Acting Lieut.-Col.) James Chambers Sproule, Royal Army Medical Corps.

To be a Member of the Military Division of the said Most Excellent Order:—

Qmr. and Capt. (Temp. Major) Andrew Ferdinand Tait, Royal Army Medical Corps.

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the undermentioned Non-commissioned Officers in recognition of valuable services rendered with the Armies in France and Flanders:—

Royal Army Medical Corps.

57078 Qmr.-Serjt. (Acting Serjt.-Major) A. B. Shaw (Wakefield).

1076 Staff-Serjt. (Acting Qmr.-Serjt.) F. C. Bowden (Chester).

CHANCERY OF THE ORDER OF SAINT MICHAEL AND SAINT GEORGE.

Downing Street,
December 12, 1919.

The King has been graciously pleased to give directions for the following appointments to the Most Distinguished Order of Saint Michael and Saint George for services rendered in connexion with Military Operations in Egypt and Palestine. Dated June 3, 1919:—

To be Additional Members of the Third Class or Companions of the said Most Distinguished Order:—

Lieut.-Col. (Acting Col.) Cathcart Garner, C.B.E., M.B., retired pay (late Royal Army Medical Corps.)

Lieut.-Col. Percy Samuel Lelean, C.B., F.R.C.S., Royal Army Medical Corps.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W. 1,
December 12, 1919.

The King has been graciously pleased to give orders for the following promotions in, and appointments to, the Most Excellent Order of the British Empire, in recognition of valuable services rendered in connexion with Military Operations in Egypt and Palestine. To be dated June 3, 1919.

To be Officers of the Military Division of the said Most Excellent Order:—

Temp. Capt. Graham Colville Ramsey, M.B., Royal Army Medical Corps.

Capt. (Acting Major) Arthur Eaton Richmond, Royal Army Medical Corps.

Temp. Capt. Percy Peter James Stewart, M.B., F.R.C.S., Royal Army Medical Corps.
To be a Member of the Military Division of the Most Excellent Order :—
El Temp. Mulazim Awal Salama Yusef Effendi, Salama, Egypt, Army Medical Corps.

Australian Imperial Forces.

To be Officers of the Military Division of the said Most Excellent Order :—
Capt. Francis Aloysius Comins, Australian Army Medical Corps.
Hon. Lieut. and Qmr. Francis Hardwick Phillips, Australian Army Medical Corps.
Capt. (Temp. Major) Harvey Sutton, Australian Army Medical Corps.

New Zealand Forces.

To be a Commander of the Military Division of the said Most Excellent Order :
Lieut.-Col. Robert Henry Walton, M.D., F.R.C.S., New Zealand Army Medical Corps.

AWARDED THE DISTINGUISHED SERVICE ORDER.

Australian Imperial Force.

Lieut.-Col. John Robert McNeil Beith, Australian Army Medical Corps, attached 2nd Light Horse Field Ambulance.

Lieut.-Col. Meylies Wyamarus Cave, Australian Army Medical Corps, attached 1st Light Horse Field Ambulance.

AWARDED THE MILITARY CROSS.

Capt. Thomas Pollock Inglis, M.B., Royal Army Medical Corps, Special Reserve.

New Zealand Force.

Capt. John Graham Gow, M.B., New Zealand Medical Corps, attached Well. Mounted Rifle R.

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the following Warrant Officer in recognition of valuable services rendered with the British Forces in Egypt and Palestine :—

Royal Army Medical Corps.

31325 Temp. Serjt.-Major J. H. M. Edwards (Farnham).

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W.1.
December 12, 1919.

The King has been graciously pleased to give orders for the following appointment to the Most Excellent Order of the British Empire, in recognition of valuable services rendered in connexion with Military Operations in Italy. To be dated June 3, 1919.

To be an Officer of the Military Division of the said most Excellent Order :—
Qmr. and Capt. (Temp. Major) Ernest Victor Saunders, Royal Army Medical Corps.

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the following Men in connexion with valuable services rendered with the British Forces in Italy.

Royal Army Medical Corps.

528294 Pte. (Acting Serjt.) E. Hargreaves (Burnley).
528157 Pte. (Acting Cpl.) T. H. Rae (Sunderland).

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W.1.
December 12, 1919.

The King has been graciously pleased to give orders for the following appointment to the Most Honourable Order of the Bath, for valuable services rendered in connexion with Military Operations in the Balkans, and with the British Army of the Black Sea. Dated June 3, 1919.

To be an Additional Member of the Military Division of the Third Class, or Companion, of the said Most Honourable Order :—

Lieut.-Col. and Brevet Col. (Temp. Col.) William Henry Snyder Nickerson, V.C., C.M.G. M.B., Royal Army Medical Corps.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W.1.
December 12, 1919.

The King has been graciously pleased to give orders for the following promotions in, and appointments to, the Most Excellent Order of the British Empire, in recognition of valuable services rendered in connexion with Military Operations in the Balkans, and with the Army of the Black Sea. To be dated June 3, 1919.

To be a Commander of the Military Division of the said Most Excellent Order :—
Dr. (Mrs.) Agnes Moore Livingstone-Learmonth, Royal Army Medical Corps.

To be Officers of the Military Division of the said Most Excellent Order :—
Temp. Capt. (Acting Major) Francis Robert Brown, M.B., Royal Army Medical Corps.
Qmr. and Capt. James William Corking, Royal Army Medical Corps (Territorial Force).
Capt. (Acting Major) Bernard Langridge Davies, Royal Army Medical Corps (Territorial Force).
Dr. (Miss) Edith Blake Hollway, M.B., B.S., Royal Army Medical Corps.

To be a Member of the Military Division of the said most Excellent Order .—
Qmr. and Capt. Robert Ashton, Royal Army Medical Corps.

War Office,
December 12, 1919.

The King has been graciously pleased to approve of the undermentioned rewards for distinguished services in connexion with Military Operations in the Balkans and with the British Army of the Black Sea. Dated June 3, 1919 :—

To be Brevet Lieutenant-Colonel :—

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of Officers belonging to these categories as applicable.)

Major (Acting Lieut.-Col.) O. Ievers, D.S.O., M.B., Royal Army Medical Corps.

Awarded the Military Cross.

Temp. Capt. James Ernest Finlay, M.B., Royal Army Medical Corps.
Temp. Capt. Harold Ernest Heapy, M.D., Royal Army Medical Corps.
Capt. George Mundell Hetherington, M.B., Royal Army Medical Corps (Special Reserve).

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the following Warrant Officers, Non-commissioned Officers and Men, in recognition of valuable services rendered with the British Army of the Black Sea :—

Royal Army Medical Corps.

497004 Serjt.-Major W. G. Mildenhall (Teddington).
493013 Qmr.-Serjt. W. A. Davies (Maidstone).
89506 Staff-Serjt. (Acting Serjt.-Major) W. J. Coupland (Bournemouth).
79335 Serjt. W. Kampff (Shepherd's Bush).
493282 Serjt. A. A. Ovenden (Maidstone).
110318 Cpl. (Acting Serjt.-Major) O. E. L. Jones (Anglesey).
21216 Pte. (Acting Cpl.) R. E. Billingham (Bristol).
77533 Pte. E. Hayes (Limerick).

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W. 1.
December 24, 1919.

The King has been graciously pleased to give orders for the following promotions in and appointments to the Most Excellent Order of the British Empire, in recognition of valuable services rendered in connexion with military operations in East Africa. To be dated June 3, 1919 :—

South African Forces.

To be an Officer of the Military Division of the said Most Excellent Order :—
Lieut.-Col. Robert Milner-Smyth, South African Medical Corps.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

Lord Chamberlain's Office,
St James's Palace, S.W.
December 12, 1919.

The King has been graciously pleased to give orders for the following appointments to the Most Honourable Order of the Bath for services rendered in connexion with the war. Dated June 3, 1919 :—

To be Additional Members of the Military Division of the Third Class, or Companions, of the said Most Honourable Order :—

Col. Oliver Long Robinson, C.M.G., K.H.P., late Royal Army Medical Corps.
Col. Harry Alexander Hinge, C.M.G., D.S.O., late Royal Army Medical Corps.
Col. Herbert John Martin Buist, C.M.G., D.S.O., M.B., late Royal Army Medical Corps.

CHANCERY OF THE ORDER OF SAINT MICHAEL AND SAINT GEORGE.

Downing Street.
December 12, 1919.

The King has been graciously pleased to give directions for the following appointments to the Most Distinguished Order of Saint Michael and Saint George, for services rendered in connexion with the war. Dated June 3, 1919 :—

To be additional Member of the Third Class, or Companion, of the said Most Distinguished Order :—

Col. Denis Joseph Collins, M.D., late Royal Army Medical Corps.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W. 1.
December 12, 1919.

The King has been graciously pleased to give orders for the following promotions in, and appointments to, the Most Excellent Order of the British Empire, in recognition of valuable services rendered in connexion with the war. To be dated June 3, 1919:—

To be Commanders of the Military Division of the said Most Excellent Order:—

Temp. Lieut.-Col. James Vincent Blachford, Royal Army Medical Corps.
Lieut.-Col. Monckton O'Dell Braddell, M.B., Royal Army Medical Corps.
Lieut.-Col. Herbert George Cook, Royal Army Medical Corps.
Temp. Major Harold Delf Gillies, F.R.C.S., Royal Army Medical Corps.
Temp. Lieut.-Col. Edwin Goodall, M.D., F.R.C.P., Royal Army Medical Corps.
Temp. Lieut.-Col. William Harding, M.D., Royal Army Medical Corps.
Major James William Beeman Hodsdon, M.D., F.R.C.S., Royal Army Medical Corps (Territorial Force).
*Temp. Lieut.-Col. John Keay, M.D., F.R.C.P., Royal Army Medical Corps.
Temp. Lieut.-Col. Harold Andrew Kidd, Royal Army Medical Corps.
Major Arthur Williams Ormond, F.R.C.S., Royal Army Medical Corps (Territorial Force).
Temp. Lieut.-Col. Alexander Simpson, M.D., Royal Army Medical Corps.
*Major (Temp. Lieut.-Col.) Arthur Briton Smallman, D.S.O., M.D., Royal Army Medical Corps.
Lieut.-Col. and Brevet Col. Samuel John Thomson, C.I.E., Indian Medical Service.
*Temp. Lieut.-Col. William James Nathaniel Vincent, Royal Army Medical Corps.
Lieut.-Col. and Brevet Col. Holburt Jacob Waring, M.D., F.R.C.S., Royal Army Medical Corps (Territorial Force).
Major and Brevet Lieut.-Col. Alfred Wright (retired pay), Royal Army Medical Corps.

*Substituted for the announcement which appeared in the *London Gazette*, dated June 3, 1919.

To be Officers of the Military Division of the said Most Excellent Order:—

Capt. John Starling Arthur, Royal Army Medical Corps (Territorial Force).
Temp. Major Robert Atwood Beaver, Royal Army Medical Corps.
Capt. Henry Edmund Gaskin Boyle, Royal Army Medical Corps (Territorial Force).
Capt. Gerald Alfred Child, M.R.C.S., L.R.C.P., Royal Army Medical Corps (Territorial Force).
Temp. Major Arthur John Cleveland, Royal Army Medical Corps.
Temp. Lieut. Col. Michael Abdy Collins, M.D., M.R.C.S., Royal Army Medical Corps.
Temp. Capt. (Acting Major) Charles Calthorp de Burgh Daly, Royal Army Medical Corps.
Capt. Sidney Herbert Daukes, M.B., Royal Army Medical Corps (Territorial Force).
Temp. Major Reginald Laidlow Davies, M.B., F.R.C.S., Royal Army Medical Corps.
Temp. Capt. William Leigh Maule Day, Royal Army Medical Corps.
Temp. Capt. Henry Devine, M.D., Royal Army Medical Corps.
Capt. (Acting Major) Richard Eager, M.D., Royal Army Medical Corps (Territorial Force).
Temp. Lieut.-Col. Samuel Charles Elgee, Royal Army Medical Corps.
Temp. Lieut.-Col. Thomas Saxby Good, Royal Army Medical Corps.
Temp. Major Charles D'Oyly Grange, M.B., F.R.C.S., Royal Army Medical Corps.
Temp. Capt. Alexander William Hendry, Royal Army Medical Corps.
Capt. (Temp. Major) Frank Arthur Hepworth, M.B., F.R.C.S., Royal Army Medical Corps (Territorial Force).
Temp. Major David Barty King, M.B., M.R.C.P., Royal Army Medical Corps.
Capt. (Acting Lieut.-Col.) William Porter MacArthur, D.S.O., M.D., F.R.C.P.I., Royal Army Medical Corps.
Capt. (Acting Major) Dalziel Buchanan McGrigor, M.B., Royal Army Medical Corps.
Major William Murray MacKay, M.B., Ch.B., Royal Army Medical Corps.
Temp. Major Hector Duncan MacPhail, M.D., Royal Army Medical Corps.
Temp. Major Thomas Ricketts Morse, L.S.A., M.R.C.S., Royal Army Medical Corps.
Major Charles Alexander Morton, F.R.C.S., Royal Army Medical Corps (Territorial Force).
Major Robert William Murray, F.R.C.S., Royal Army Medical Corps (Territorial Force).
Major William Cochrane Murray, M.B., Royal Army Medical Corps (Territorial Force).
Temp. Major Charles Noon, F.R.C.S., Royal Army Medical Corps.
Temp. Major Arthur O'Neil, M.R.C.S., Royal Army Medical Corps.
Major Frederick John Oxley, Royal Army Medical Corps.
Temp. Major John Robert Parry Phillips, Royal Army Medical Corps.
Temp. Major Norcliffe Roberts, M.B., Royal Army Medical Corps.
Temp. Major Henry Robinson, F.R.C.S., Royal Army Medical Corps.
Temp. Major Frederick Millar Rodgers, M.D., Royal Army Medical Corps.
Capt. William John More Slowan, M.D., Royal Army Medical Corps (Territorial Force).
Temp. Major Stanley Alwyn Smith, D.S.O., Royal Army Medical Corps.
Qmr. and Capt. Thomas James Spratley, Royal Army Medical Corps (Territorial Force).

Temp. Capt. Charles Ravenscroft Stewart, Royal Army Medical Corps.
Temp. Major Frederick Joshua Stuart, Royal Army Medical Corps.
Temp. Lieut.-Col. Alexander Canning Suffern, Royal Army Medical Corps.
Capt. Horace George Turney, Royal Army Medical Corps (Territorial Force).
Temp. Capt. (Acting Major) Horace Bagster Wilson, Royal Army Medical Corps.

To be Members of the Military Division of the said Most Excellent Order :—
Temp. Capt. George Edward Kinnersley, Royal Army Medical Corps.
Qmr. and Capt. Alfred Sinfield, Royal Army Medical Corps (Territorial Force).
12461 Qmr.-Serjt. Percy Frederick Cook, Royal Army Medical Corps.

Australian Imperial Forces.

To be Commanders of the Military Division of the said Most Excellent Order :—
Lieut.-Col. (Temp. Col.) Samuel Roy Burston, D.S.O., Australian Army Medical Corps.
Lieut.-Col. Henry Simpson Newland, D.S.O., Australian Army Medical Corps.
Col. Bernard James Newmarch, C.M.G., Australian Army Medical Corps.
Lieut.-Col. (Temp. Col.) John Mitchell Young Stewart, D.S.O., Australian Army Medical Corps.

To be Officers of the Military Division of the said Most Excellent Order :—
Major Thomas Lynewolde Anderson, Australian Army Medical Corps.
Capt. (Temp. Major) John Herald Balfour Brown, M.C., Australian Army Medical Corps.
Capt. George Finlay, Australian Army Medical Corps.
Major Joseph Patrick Fogarty, M.C., Australian Army Medical Corps.
Major Claude Herbert Terry, Australian Army Medical Corps.

To be a Member of the Military Division of the said Most Excellent Order :—
Hon. Lieut. and Qmr. Frederick Edward Bland, Australian Army Medical Corps.

New Zealand Forces.

To be Commanders of the Military Division of the said Most Excellent Order :—
Lieut.-Col. George Home, O.B.E., New Zealand Medical Corps.
Major Thomas McKibbon, O.B.E., New Zealand Medical Corps.
Col. Russell Tracy-Inglis, New Zealand Medical Corps.

To be Officers of the Military Division of the said Most Excellent Order :—
Capt. (Temp. Major) John Falconer Brown, M.D., New Zealand Medical Corps.
Major (Temp. Lieut.-Col.) Henry Meredith Buchanan, M.B., New Zealand Medical Corps.
Major Thomas Duncan McGregor Stout, D.S.O., F.R.C.S., New Zealand Medical Corps.
Capt. (Temp. Major) Kenneth Edwin Tapper, M.B., New Zealand Medical Corps.

To be Members of the Military Division of the said Most Excellent Order :—
Capt. Percy Chisholm, New Zealand Medical Corps.
Capt. Sydney Hartley Hay, New Zealand Medical Corps.
Major Arthur Hosking, New Zealand Medical Corps.
Capt. Henry Caldwell Tait, New Zealand Medical Corps.

South African Forces.

To be a Commander of the Military Division of the said Most Excellent Order :—
Temp. Lieut.-Col. Arthur Blackwood Ward, D.S.O., M.B., South African Medical Corps.

To be Officers of the Military Division of the said Most Excellent Order :—
Capt. William Lennox Gordon, South African Medical Corps.
*Hon. Lieut.-Col. and Qmr. George Merritt, South African Medical Corps, to date December 12, 1919.
Temp. Capt. (Acting Major) Henry Rubert Mullins, South African Medical Corps.
Major George Watson Robertson, South African Medical Corps.
Capt. (Acting Major) Walwyn Thomas, South African Medical Corps.

To be Members of the Military Division of the said Most Excellent Order :—
Capt. Innes Wares Brebner, South African Medical Corps.
Capt. Henry Echley Herbert Oakeley, South African Medical Corps.

* Substituted for the announcement which appeared in the *London Gazette* dated June 3, 1919.

War Office,
December 12, 1919.

The King has been graciously pleased to approve of the undermentioned rewards for valuable services rendered in connexion with the war. Dated June 3, 1919 :—

To be Brevet Lieutenant-Colonel :—

(On Retired List, Reserve of Officers, Special Reserve, New Army or Territorial Force, in the case of Officers belonging to these categories as applicable.)

Major H. F. Horne, M.D., T.D., West Riding Divisional Sanitary Section, Royal Army Medical Corps (Territorial Force).

To be Brevet Lieutenant-Colonel on promotion to Substantive Major :—
Capt. A. R. Wright, D.S.O., M.B., Royal Army Medical Corps.

To be Brevet Major :—

(On Retired List, Reserve of Officers, Special Reserve, New Army, or Territorial Force, in the case of officers belonging to these categories as applicable.)

Temp. Capt. E. A. Aldridge, M.C., Royal Army Medical Corps.

Note.—Since the list of rewards (announced in this *Gazette*) was placed in the hands of the printers, a number of officers have been advanced in permanent, temporary or acting rank, and in some cases temporary or acting rank has been relinquished, but it has not been found practicable to make the necessary changes in description in this *Gazette.*

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the undermentioned Warrant Officers, Non-commissioned Officers and Man, in recognition of valuable services rendered in connexion with the war :—

Royal Army Medical Corps.

26818 Qmr.-Serjt. (Acting Serjt.-Major) H. Carrington (Sale).
5202 Serjt. (Acting Staff-Serjt.) J. Roughley (St. Helens).
26961 Cpl. (Acting Serjt.) H. C. Ballinger (Cheltenham).
16524 (Temp. Serjt.-Major) H. Fandam (East London) (South Africa).
100921 Cpl. (Acting Staff-Serjt.) J. W. Handley (Stalybridge).
11558 Cpl. (Acting Staff-Serjt.) G. W. Leach (East Grinstead).
26544 Cpl. (Acting Qmr.-Serjt.) G. H. Sackville (E) (Dublin).
102121 Pte. (Acting Staff-Serjt.) W. Ennis (Dublin).

War Office,
December 15, 1919.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign.

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS CONFERRED BY THE PRESIDENT OF THE FRENCH REPUBLIC.

Médaille Militaire.

510248 Pte. Edward George Smith, 84th (1/2nd London) Field Ambulance, Royal Army Medical Corps (Grays, Kent).

Médaille d'Honneur avec Glaives (en Vermeil).

1st Class Sub-Assistant Surgeon Raghunath Sahai, I.D.S.M., Indian Medical Department, attached 59th Punjabis, Indian Army.

Médaille d'Honneur avec Glaives (en Bronze).

63099 Pte. (Acting Lance-Cpl.) Hubert Francis Arthur Gladwell, Royal Army Medical Corps (Plumstead, S.E.).

28826 Pte. (Acting Cpl.) James Cameron Stewart, Royal Army Medical Corps (Manchester).

Médaille des Epidémies (en Vermeil).

Capt. Arthur Ernest Bonham, Royal Army Medical Corps (Territorial Force).
Temp. Major (Acting Lieut.-Col.) Henry Maurice Chasseaud, M.D., Royal Army Medical Corps.
Temp. Capt. (Acting Major) Albert William Duncan Coventon, M.D., F.R.C.S., Royal Army Medical Corps.
Capt. Cromwell Gamble, M.B., Royal Army Medical Corps.
Temp. Capt. Arthur Hyde Greg, O.B.E., M.B., F.R.C.S., Royal Army Medical Corps.
Major (Acting Lieut.-Col.) Rochford Noel Hunt, D.S.O., M.B., Royal Army Medical Corps.
Capt. Archibald Oliver, M.D., Royal Army Medical Corps (Territorial Force).
Temp. Capt. John William Pell, Royal Army Medical Corps.
Major Ronald Ernest Todd, M.B., Royal Army Medical Corps.

Médaille des Epidémies (en Argent).

545181 Staff-Serjt. Tom Blakeley, 16th Sanitary Section, Royal Army Medical Corps (Carlisle).

350004 Temp. Serjt.-Major Christopher Bonehill, 19th Casualty Clearing Station, Royal Army Medical Corps (Manchester).

12283 Serjt. (Acting Qmr.-Serjt.) William Carter, 1st Casualty Clearing Station, Royal Army Medical Corps (Portsmouth).

545346 Pte. Walter Richards Dawe, 48th Sanitary Section, Royal Army Medical Corps (High Wycombe).

47494 Pte. Albert Fackrell, 7th Casualty Clearing Station, Royal Army Medical Corps Clapham, S.W.)

18383 Serjt. (Temp. Serjt.-Major) Moses William Hutchings, 6th General Hospital, Royal Army Medical Corps (Enfield, N.).

32110 Qmr.-Serjt. (Acting Serjt.-Major) John William Jolly, Royal Army Medical Corps (Wood Green, N.).

52768 Serjt. (Acting Staff-Serjt.) Edwin Robert Lanham, 41st Sanitary Section, Royal Army Medical Corps (Harlesden, N.W.).

62115 Serjt. Arthur Aubrey Erskine McLachlan, Royal Army Medical Corps (Catford, S.E.).

18863 Qmr.-Serjt. (Temp. Serjt.-Major) Joseph Mulcahy, 22nd Casualty Clearing Station, Royal Army Medical Corps (Ballynaword, Limerick).

19126 Serjt. (Temp. Serjt.-Major) Frederick Herbert Perkins, Royal Army Medical Corps (Leyton).

68898 Qmr.-Serjt. Bertie Prime, Royal Army Medical Corps (Warwick).

307074 Serjt. George Prince, 51st Casualty Clearing Station, Royal Army Medical Corps (Territorial Force) (Aberdeen).

93302 Serjt.-Major Joseph Purves, 39th Stationary Hospital, Royal Army Medical Corps (Glasgow).

18433 Staff-Serjt. (Temp. Serjt.-Major) James Arthur Shaw, 4th General Hospital, Royal Army Medical Corps (Camberwell)

55029 Pte. Albert Smith, 18th Casualty Clearing Station, Royal Army Medical Corps (Tipton).

505015 Pte. (Acting Serjt.) George Alfred Edward Styles, 1/1st Home Counties Division, Sanitary Section, Royal Army Medical Corps (Gravesend).

ARMY MEDICAL SERVICE.

Col. Edward M. Hassard, half pay list, retires on retired pay, dated September 15, 1919.

Col. Anthony H. Waring, D.S.O., is placed on half pay, dated November 26, 1919.

Major-Gen. Sir Henry N. Thompson, K.C.M.G., C.B., D.S.O., M.B., is placed on the half pay list, dated November 18, 1919.

Col. Norman Faichnie, M.B., is placed on half pay, dated November 21, 1919.

Col. Arthur Kennedy retires on retired pay, dated November 15, 1919.

ROYAL ARMY MEDICAL CORPS.

Major Thomas H. Gibbon, O.B.E., M.D., to be Temporary Lieutenant-Colonel whilst specially employed, dated October 24, 1919.

The undermentioned relinquish the acting rank of Lieutenant-Colonel :—

Dated August 22, 1919.—Capt. George D'R. Carr, M.C.

Capt. John J. Molyneaux, M.B., relinquishes the acting rank of Major on ceasing to be specially employed, dated November 14, 1919.

Capt. James Biggam, M.C., M.B., is seconded for service with the Egyptian Army, dated October 17, 1919.

Lieut.-Col. and Brevet Col. Edgar E. Powell, D.S.O., to be acting Colonel, dated June 12, 1919.

Major Richard C. Hallowes, D.S.O., M.B., relinquishes the Temporary rank of Lieutenant-Colonel, dated February 16, 1919.

The undermentioned relinquish the acting rank of Lieutenant-Colonel :—

Dated March 22, 1919.—Capt. George S. Parkinson, D.S.O.

Dated May 1, 1919.—Major Edward J. Kavanagh, D.S.O., M.C., M.B.

Dated September 27, 1919.—Major Thomas E. Harty, D.S.O.

Capt. Charles L. Franklin, M.C., M.B., to be Acting Lieutenant-Colonel whilst commanding a medical unit, from April 16 to June 25, 1919.

The undermentioned relinquish the acting rank of Major :—

Dated September 27, 1919.—Capt. Charles E. L. Harding, M.B.

Capt. John Berchmans Minch, M.B., from Special Reserve, to be Captain, dated March 30, 1918, but not to reckon for pay or allowances prior to November 1, 1919, with precedence next below J. P. Litt.

Lieut.-Col. and Brevet Col. Lawrence W. Harrison, D.S.O., M.B., K.H.P., retires on retired pay, dated November 24, 1919. (Substituted for the notification in the *Gazette* of November 17, 1919.)

Major Alfred B. Hinde, O.B.E., retired pay, relinquishes the acting rank of Lieutenant-Colonel on ceasing to command a medical unit, dated May 1, 1919.

Major Ralph F. M. Fawcett, D.S.O., retires on retired pay, dated December 12, 1919.

Capt. Lewis R. Shore, M.C., is placed on the half pay list on account of ill-health caused by wounds, dated November 6, 1919.

Temp. Major Harry Robinson, F.R.C.S., relinquishes his commission on ceasing to be employed at the Horton (County of London) War Hospital, dated October 24, 1919, and retains the rank of Major.

Capt. Robert H. Alexander, M.C., M.B,, relinquishes the acting rank of Major, dated August 28, 1919.

The undermentioned Majors to be Temporary Lieutenant-Colonels while specially employed :—

Dated September 12, 1919.—John L. Wood, O.B.E.

Dated September 26, 1919.—Archibald S. Littlejohns, D.S.O.

(Substituted for the notifications regarding these officers in the *Gazette* of October 29, 1919.)

Major and Brevet Lieut.-Col. Ralph B. Ainsworth, D.S.O., to be Temporary Lieutenant-Colonel whilst specially employed, dated October 31, 1919. (Substituted for the notification in the *Gazette* of November 14, 1919.)

Capt. Sidney M. Hattersley M.C., M.B., to be Temporary Major whilst specially employed, dated September 16, 1919.

Capt. James Y. Moore, O.B.E., relinquishes the acting rank of Major, dated April 14, 1919.

ROYAL ARMY MEDICAL CORPS FUND.

Royal Army Medical Corps Officers Benevolent Society.

The Secretary desires to inform all Subscribers that this office will be transferred from 124, Victoria Street, S.W. 1, to--

76, Claverton Street, S.W. 1.

from December 22, 1919.

E. M. Wilson, *Lieut-Colonel,*
Secretary.

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

The following letter has been sent to officers of the Corps by the Chairman of the Committee of the Royal Central Mess Fund, and is published for general information :—

Dear Sir,—The Committee desire to bring to your notice the existence of the Royal Army Medical Corps Central Mess Fund.

The general functions of the Fund are to help in the proper upkeep of the permanent Messes of the Corps, by means of both money grants and loans, and to give grants to make the initial outlay required to provide camp mess kit in Commands and Districts for the use of Medical Units taking part in manœuvres, etc.

During the past five years the Fund has been of special assistance to the Messes which were hard hit by war conditions. More than £1,400 has already been paid to Messes in grants and loans during the current year.

The personal advantages to officers subscribing to the Fund are that they are relieved of the payment of all joining contributions, and further promotion contributions, to permanent Messes, such contributions being paid by the Fund.

At present the permanent R.A.M.C. Messes are located in London, Aldershot, Netley, Woolwich, Curragh Camp, Cosham and at the R.A.M.C. Depot, Tweseldown Camp, Aldershot; in India, at Bangalore, Lucknow, Peshawar and Rawal Pindi. As the joining contributions to these vary from two to four days' pay at home, and somewhat less in India, it is obvious that there is a great financial advantage in becoming a subscriber to the Fund at once, more especially when it is realized that all officers joining the Corps in normal times have to join the Mess at both Millbank and Tweseldown Camp, after which they are liable to be posted to one of the other large stations with a Mess.

The Committee consider that as the Central Mess Fund is now an established institution of the Corps, it is most desirable that it should have your support. Before the war, four-fifths of the officers of the Corps subscribed to it. Notices have been sent out from time to time, to all those who have joined since, but in many cases no doubt these have not reached them. I would point out that officers frequently complain that they have not been acquainted with the benefit acquired by joining the Fund; I trust, therefore, that you will not disregard this letter, and that if you wish further particulars you will write at once to the Hon. Secretary, R.A.M.C. Central Mess Fund, Capt. J. T. Clapham, 3, Homefield Road, Wimbledon, London, S.W. 19.

Should you desire to become a subscriber to the Fund, would you kindly complete the enclosed banker's order and send it direct to your agents.

In case you may have already paid a joining contribution to any of the above-mentioned Messes, the sum so paid should be deducted from the entrance fee mentioned on the order, and an explanatory note sent to the Hon. Secretary addressed as above.

R.A.M.C. Depot,
Tweseldown Camp,
near Aldershot,
December, 1919.

Yours faithfully,
P. Davidson, *Lieut.-Col.,*
Chairman of Committee,
R.A.M.C. Central Mess Fund.

AUXILIARY ROYAL ARMY MEDICAL CORPS FUNDS.

The usual Quarterly Committee Meeting was held on Friday, December 19, at 11, Chandos Street, Cavendish Square, W. 1. Three grants were made in the Benevolent Branch for Officers, amounting to £290, and fourteen grants in the Relief Branch for the rank and file, amounting to £624.

These Funds are for the relief of widows and orphans of commissioned officers and non-commissioned officers and men of the rank and file of the Royal Army Medical Corps, Special Reserve, Territorial Force and New Armies, and also for the relief of the children of those who have been so severely damaged in the present war that they need help for the education of children.

Requests for relief should be addressed to the Hon. Secretary, at the offices of the Funds at 11, Chandos Street, Cavendish Square, W. 1.

CONGRESS OF THE ROYAL SANITARY INSTITUTE.

THE RIGHT HON. VISCOUNT ASTOR has consented to accept the office of President of the Thirty-first Congress of the Royal Sanitary Institute to be held at Birmingham from July 19 to 24, 1920.

HEALTH WEEK, MAY 2-8, 1920.

THE RIGHT HON. THE LORD MAYOR OF LONDON has consented to act as Chairman of the General Committee promoting Health Week to be held from May 2 to May 8, 1920.

MARRIAGE.

SAMPSON—WOODHOUSE.—On November 26, at the Roman Catholic Church, Palace Street, Major F. C. Sampson, D.S.O., R.A.M.C., of Scarriff, co. Clare, to Mary D. Woodhouse, R.R.C., Q.A.I.M.N.S., of Goodwood, Egerton Park, Rockferry.

16115 Serjt.-Major E. B. Dewberry, Royal Army Medical Corps, has been elected a member of the Royal Institute of Public Health, London, and also of the Royal Sanitary Institute, London.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

Major due for India wishes an exchange to remain at home. Good terms offered. Apply T.H.G., c/o "Journal of the R.A.M.C.," 8, Serle Street, London, W.C. 2.

R.A.M.C. Lieut.-Colonel at present at home on leave wishes to hear from an officer of his own rank serving in the British Isles who is willing to proceed to India to complete a term of duty ending in June, 1922. Address Lieut.-Col. J. G. Gill, R.A.M.C., Junior United Service Club, London.

Captain, with 3 years' service to complete in Egypt, desires exchange to home station, England. Apply Capt. A. O. Chambers, c/o Messrs. Holt & Co., stating terms.

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Service Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

Number of Reprints	Number of Pages	Cost of Reprints	Cost of Excerpts*	Extra for Covers for Reprints			
				As Journal, Printed on Front	As Journal, Plain, Unprinted	Cheaper Paper, Printed on Front	Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
12	4	0 5 6	0 2 6				
	8	0 10 0	0 5 0	8 6	2 3	7 0	1 6
	16	0 16 6	0 8 6				
25	4	0 6 9	0 3 0				
	8	0 12 0	0 5 9	9 9	3 0	8 9	2 0
	16	1 1 0	0 10 6				
50	4	0 9 0	0 4 0				
	8	0 15 0	0 7 0	12 0	4 3	10 0	2 6
	16	1 6 6	0 12 6				
100	4	0 12 0	0 6 3				
	8	1 0 0	0 10 0	16 0	8 0	14 0	5 0
	16	1 17 0	0 15 6				
200	4	0 19 0	0 9 0				
	8	1 10 0	0 14 0	1 2 0	15 0	18 0	10 0
	16	2 12 0	0 18 0				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

Cases for Binding Volumes.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 3s. 9d. net; binding, 3s. 9d.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are

inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "**Journal of the Royal Army Medical Corps,**" 56, Cornwall House, Stamford Street, S.E. 1.

Communications have been received from the following: Majors G. Cooper and F. C. Pybus; Capts. T. O. Thompson and F. E. Reynolds; H. M. Woodcock, Esq., H. E. Roaf, Esq., E. H. Starling, Esq., C.M.G., F.R.S.

The following publications have been received:—

British: The Journal of Tropical Medicine and Hygiene, The Hospital, Fifth Annual Report of the Medical Research Committee, Bulletin of Entomological Research, Agricultural Research Institute, Pusa, The Journal of the Army Service Corps, Guy's Hospital Gazette, The Journal of State Medicine, The Medical Journal of Australia, Veterinary Review, Tropical Diseases Bulletin, The Medical Press, The Royal Engineers' Journal, The Practitioner, Transactions of the Society of Tropical Medicine and Hygiene, Medical Research Committee Statistical Report, Journal of the Royal United Service Institution, St. Bartholomew's Journal, Public Health, The Medical Review, Edinburgh Medical Journal, The Indian Medical Gazette, The Journal of the Royal Army Service Corps, Annals of Tropical Medicine and Parasitology, The Indian Medical Journal, Proceedings of the Royal Society of Medicine.

Foreign: Bulletin of the Johns Hopkins Hospital, Surgery, Gynæcology and Obstetrics, The Military Surgeon, Archives Médicales Belges, Office International d'Hygiène Publique, Le Bulletin Médical, Bulletin de la Société de Pathologie Exotique, Zeitschrift für Militärärzte, Colonies et Marine, Norsk Tidsskrift for Militærmedicin, Archives de l'Institut Pasteur de Tunis, Bulletin de l'Institut Pasteur, L'Ospedale Maggiore, Memorias do Instituto Oswaldo Cruz, The Research Laboratory Parke, Davis and Co., Detroit, Mich., War Medicine, The American Journal of Syphilis, Cannes Medical Conference, Abstracts of Bacteriology, Bulletin of the League of Red Cross Societies, Giornale di Medicina Militare, Archives de Médecine et Pharmacie Navales.

MANAGER'S NOTICES.

The Journal of the Royal Army Medical Corps is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," Cornwall House, Stamford Street, S.E. 1, and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

The Hon. Manager,
"Journal of the Royal Army Medical Corps,"
Cornwall House, Stamford Street, S.E. 1.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

February, 1920.

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
December 18, 1919.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Man:—

France and Flanders.

36803 Pte. (Acting Lance-Serjt.) F. T. G. Buchanan, M.M., Royal Army Medical Corps (East Ham). (M.M. gazetted January 28, 1918.)

His Majesty the King has been graciously pleased to approve of the award of the Military Medal for Bravery in the Field to the undermentioned Men:—

France and Flanders (except where otherwise stated).
Royal Army Medical Corps.

65242 Pte. F. C. Butcher, 8th Field Ambulance (Twickenham).
35761 Pte. H. W. Carter, 8th Field Ambulance (Ewell).
22449 Pte. F. H. Cornall, 14th Field Ambulance (Colne).
102969 Pte. G. W. Crabtree, 15th Field Ambulance (Kirkheaton).
62823 Pte. R. Devaney, 14th Field Ambulance (Oldham).
95471 Pte. R. Dickinson, 14th Field Ambulance (Chester-le-Street).
8972 Pte. R. W. Dixon, 14th Field Ambulance (South Shields).
401450 Pte. H. Fryer, 8th Field Ambulance (Leeds).
52319 Pte. (Acting Lance-Cpl.) N. G. Horne, 15th Field Ambulance (Inach).
10486 Pte. F. Knowles, 14th Field Ambulance (Normanton).
53618 Pte. J. McIlroy, 13th Field Ambulance (Belfast).
7719 Pte. (Acting Cpl.) J. W. Maskrey, 15th Field Ambulance (Derby).
6676 Pte. A. R. Woods, 7th Field Ambulance (Ashford).

Amendments.

The following are the correct descriptions of the undermentioned Non-commissioned Officer and Men, whose names have recently appeared in the *London Gazette*, for the award of the Military Medal or Meritorious Service Medal:—

Military Medal.

London Gazette, dated February 11, 1919.—316357 Pte. W. Getgood, Royal Army Medical Corps. (Gazetted as Getwood.)

London Gazette, dated June 17, 1919.—17810 Pte. F. J. Suitters, 16th Field Ambulance, Royal Army Medical Corps. (Gazetted as Snitters.)

London Gazette, dated June 3, 1919.—19827 Staff-Serjt. (Acting Qmr.-Serjt) J. W. Baxter, M.M., Royal Army Medical Corps; 13628 Pte. (Acting Serjt.) W. Wathen, Royal Army Medical Corps. (Gazetted as Walthen.)

War Office,
January 3, 1920.

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the undermentioned Warrant Officer, Non-commissioned Officer and Men in recognition of valuable services rendered with the British Forces in North Russia :—

MURMANSK COMMAND.

Royal Army Medical Corps.

31067 Serjt.-Major G. Lewington (Swindon).
19086 Staff-Serjt. A. Wain (Stepney).
155061 Pte. (Acting Cpl.) J. Bates (Exeter).
357465 Pte. (Acting Lance-Cpl.) T. Withers (Manchester).
303122 Pte. D. Watson (Aberdeen).

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Man for Bravery in the Field, with the British Forces in North Russia :—

ARCHANGEL COMMAND.

Royal Army Medical Corps.

17363 Pte. J. Bradshaw, M.M. (Ballywatermoy, Co. Antrim). (M.M. gazetted October 27, 1916.)

His Majesty The King has been graciously pleased to approve of the award of the Military Medal to the undermentioned Non-commissioned Officer and Men for bravery in the Field with the British Forces in North Russia :—

ARCHANGEL COMMAND.

Royal Army Medical Corps.

18418 Staff-Serjt. G. Smith (Crowthorne).
220098 Pte. (Acting Cpl.) F. Willis (Costram).
200032 Pte. J. R. West (Newport Pagnell).
220044 Pte. T. Cochrane (Kirkcaldy).
94298 Pte. G. Gibbons (Manchester).

His Majesty The King has been graciously pleased to approve of the award of the Meritorious Service Medal to the undermentioned Non-commissioned Officers in recognition of valuable services rendered with the British Forces in North Russia :—

ARCHANGEL COMMAND.

Royal Army Medical Corps.

56914 Staff-Serjt. C. Keating (Dublin).
2127 Cpl. (Acting Serjt.) A. E. G. Marsh (Blackpool).

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the following Non-commissioned Officers and Man in recognition of valuable services rendered with the British Forces in North Russia :—

ARCHANGEL COMMAND.

Royal Army Medical Corps.

44337 Qmr.-Serjt. A. S. Clarke (Wandsworth).
127194 Staff-Serjt. A. Morgan (Hanley).
73828 Pte. A. Oakes, 155th Field Ambulance (South Shields).

War Office,
January 12, 1920.

The names of the undermentioned Officers, Warrant Officers and Non-commissioned Officers have been brought to the notice of the Secretary of State for War for valuable services rendered on Hospital Ships during the War :—

Capt. I. M. Byers, M.B., Royal Army Medical Corps.
Temp. Capt. (Acting Major) W. A. Clayton, Royal Army Medical Corps.
Major E. L. D. Dewdney, Royal Army Medical Corps (Territorial Force).
Temp. Capt. H. B. Emerson, Royal Army Medical Corps.
Temp. Capt. J. H. Glover, M.B., Royal Army Medical Corps.
Capt. J. W. Grice, Royal Army Medical Corps.
Temp. Capt. W. R. G. Hamilton, F.R.C.S., Royal Army Medical Corps.
Temp. Major J. G. Heath, Royal Army Medical Corps.
Temp. Capt. T. Heywood, M.D., Royal Army Medical Corps.
Temp. Capt. W. P. Jones, Royal Army Medical Corps.

Temp. Capt. H. A. Lane, Royal Army Medical Corps.
Temp. Capt. J. M. Lazenby, M.B., Royal Army Medical Corps.
Temp. Capt. G. W. P. Maitland, M.B., Royal Army Medical Corps.
Temp. Capt. (Acting Major) H. McIntyre, Royal Army Medical Corps.
Temp. Major R. T. Meadows, D.S.O., M.D., Royal Army Medical Corps.
Temp. Capt. (Acting Major) H. H. O'Neffernan, Royal Army Medical Corps.
Surg.-Major B. Pares, C.M.G., D.S.O., Royal Horse Guards.
Lieut. (Acting Capt.) E. H. Rainey, Royal Army Medical Corps.
Temp. Major P. J. A. Seccombe, M.B., Royal Army Medical Corps.
Temp. Capt. R. E. Smith, Royal Army Medical Corps.
Temp. Major T. Walcot, M.D., Royal Army Medical Corps.
Temp. Major A. W. Wilcox, M.D., Royal Army Medical Corps.
Lieut.-Col. H. A. Williams, D.S.O., M.B., Indian Medical Service.
517013 Serjt.-Major J. D. C. Daly, Royal Army Medical Corps.
4427 Serjt. A. H. Richards, Royal Army Medical Corps.
12053 Serjt.-Major W. J. B. Ross, Royal Army Medical Corps.
5239 Serjt. S. R. Stow, Royal Army Medical Corps.
48467 Serjt. E. T. Thomas, Royal Army Medical Corps.
6608 Cpl. S. G. Wilce, Royal Army Medical Corps.
57040 Staff-Serjt. (Acting Serjt.-Major) P. C. Williams, Royal Army Medical Corps.

FRANCE.

The names of the undermentioned Officers and Men are to be added to those brought to notice for distinguished and gallant services and devotion to duty by Field-Marshal Sir Douglas Haig, K.T., G.C.B., O.M., G.C., V.O., K.C.I.E., late Commander-in-Chief the British Armies in France, in his dispatch of March 16, 1919. (Published in the Supplement of *London Gazette*, dated July 5, 7, 8, 9, 10 and 11, 1919. (Nos. 31435, 31437, 31439, 31442, 31446 and 31448 respectively)) :—

Royal Army Medical Corps.

Temp. Capt. H. Body, attached 4th Brigade, Royal Garrison Artillery.
Col. N. Faichnie, M.B. (formerly Royal Army Medical Corps).
Major J. H. Gurley, 44th Casualty Clearing Station.
Capt. D. C. Scott, attached 2/1st (West Riding) Field Ambulance, Royal Army Medical Corps (Territorial Force).
5179 Pte. J. N. Carter, 12th Stationary Hospital.
20947 Pte. (Acting Lance-Cpl.) J. W. Elliott.
25025 Pte. (Acting Lance-Cpl.) T. Pinkney, 33rd Casualty Clearing Station.

Royal Army Medical Corps (Territorial Force).

314080 Pte. E. W. Smith, 1/3rd (East Lancashire) Field Ambulance.

The names of the undermentioned Officers, Warrant Officer, Non-Commissioned Officers and Men are to be added to those brought to notice for distinguished and gallant services by General Sir E. H. H. Allenby, G.C.B., G.C.M.G., Commander-in-Chief, Egyptian Expeditionary Force, in his dispatch of March 5, 1919. (Published in the Supplement of the *London Gazette*, dated June 5, 1919 (No. 31383)):—

COMMANDS AND STAFF.

Capt. (Acting Major) A. E. Richmond, Royal Army Medical Corps.

ROYAL ARMY MEDICAL CORPS.

Temp. Capt. W. I. Adams, F.R.C.S.I.
Lieut. (Temp. Capt.) W. M. Cameron, M.B.
Temp. Capt. T. L. Clark, M.B.
Temp. Capt. W. E. R. Dimond.
Lieut.-Col. (Acting Col.) C. Garner, C.B.E., M.B. (retired pay).
Temp. Capt. F. W. Grant.
Lieut.-Col. P. S. Lelean, C.B., F.R.C.S.
Temp. Capt. F. A. L'Estrange, M.B.
Capt. R. H. Maingot.
Temp. Capt. T. D. Miller, M.B.
Temp. Capt. G. C. Ramsay, M.B.
Captain P. P. J. Stewart, M.B., F.R.C.S.Edin.
Temp. Capt. S. M. Vassallo, M.D.
Temp. Capt. M. J. T. Wallis.
Temp. Capt. H. G. E. Williams, M.B.
25934 Serjt. F. S. Bradley, attached 127th Indian Combined Field Ambulance.
89839 Pte. J. E. Bradley, 15th Combined Clearing Hospital.
31323 Temp. Serjt.-Major J. H. M. Edwards, 12th Cavalry Brigade Field Ambulance.

112439 Pte. C. Few, 47th Stationary Hospital.
71797 Pte. J. H. Ingram, 74th Casualty Clearing Station.
100440 Pte. W. H. Painter, attached British Military Hospital, Akaba.
120236 Pte. A. Robinson.
24321 Cpl. J. Rogers, attached 2/1st (E. Ang.) Field Ambulance, Royal Army Medical Corps (Territorial Force).
19744 Staff-Serjt. R. W. Simmons, 129th Combined Field Ambulance.
25107 Serjt. (Acting Qmr.-Serjt.) R. Slattery, attached 1st (Egypt) Stationary Hospital.

ROYAL ARMY MEDICAL CORPS (SPECIAL RESERVE).

Capt. D. R. Hennessy.
Capt. P. W. Ransom, M.B.

ROYAL ARMY MEDICAL CORPS (TERRITORIAL FORCE).

Capt. (Acting Lieut.-Col.) J. Blackwood.
Capt. S. A. Mann.
Capt. C. H. Welsh.
Capt. R. Willan, M.B.
536293 Serjt. L. H. Andrews, 2/5th (London) Field Ambulance, attached 160th Indian Combined Field Ambulance.
415053 Pte. F. Darlington, 1/1st (N. Mid.) Mounted Brigade Field Ambulance, attached Hyderabad Imperial Service Lancers.
536197 Pte. C. Devereux, 2/5th (London) Field Ambulance.
530115 Pte. A. H. J. Hardy, 2/5th (London) Field Ambulance, attached 5th Malaria Diagnosis Station.
538468 Pte. C. R. Hodgson, 2/6 (London) Field Ambulance, attached 6th Malaria Diagnosis Station.
536461 Pte. W. C. Jeffrey, 2/5th (London) Field Ambulance, attached 5th Malaria Diagnosis Station.
416068 Pte. J. King (Notts and Derby) Mounted Brigade Field Ambulance.
315131 Cpl. J. McDougall, 3/1st (Lowland) Mounted Brigade Field Ambulance, attached Headquarters, 4th Cavalry Division.
366065 Staff-Serjt. W. Morcombe, 1/2nd (Welsh) Field Ambulance, attached 170th Indian Combined Field Ambulance.
534270 Serjt. H. E. Romain, 2/4th (London) Field Ambulance, attached 121st Combined Field Ambulance.

ITALY.

The names of the undermentioned Officers and Non-commissioned Officers are to be added to those brought to notice for distinguished and gallant services and devotion to duty by General F. R. Earl of Cavan, K.P., K.C.B., M.V.O., Commander-in-Chief of the British Forces in Italy, in his despatch on January 18, 1919. (Published in the Supplement of the *London Gazette*, dated June 5, 1919 (No. 31384)):—

Royal Army Medical Corps.

Temp. Capt. (Acting Major) J. C. L. Day.
Temp. Capt. (Acting Major) H. E. Gamlen.
Lieut. W. R. McLinden (Special Reserve), attached 1/3rd (S. Midland) Field Ambulance, Royal Army Medical Corps (Territorial Force).
90467 Serjt. (Acting Serjt.-Major) A. R. Bett.
1970 Serjt. (Acting Serjt.-Major) W. J. G. Brunt, 1/3rd (S. Midland) Field Ambulance, Royal Army Medical Corps (Territorial Force).
38235 Serjt. A. Elliot, 69th Field Ambulance.
34778 Serjt. (Acting Staff-Serjt.) J. C. Lamb, 1/3rd (S. Midland) Field Ambulance, Royal Army Medical Corps (Territorial Force).

MEDITERRANEAN LINES OF COMMUNICATION.

The name of the undermentioned Officer is to be added to those brought to the notice of the Secretary of State for War for valuable special services on the Mediterranean Lines of Communication. (Published in the Supplement of the *London Gazette*, dated October 7, 1918 (No. 30939)):—
Col. J. C. B. Statham, C.M.G., Army Medical Service.

MESOPOTAMIA.

The names of the undermentioned Men are to be added to those brought to notice for distinguished and gallant services and devotion to duty by Lieut.-Gen. W. R. Marshall, K.C.B., K.C.S.I., Commanding-in-Chief, Mesopotamian Expeditionary Force, in his dispatch of April 15, 1918. (Published in the Supplement of the *London Gazette*, dated August 27, 1918 (No. 30867)):—
100412 Pte. A. J. Bobbett, Royal Army Medical Corps.
20675 Pte. (Acting Cpl.) H. J. Dore, Royal Army Medical Corps.
29229 Pte. (Acting Cpl.) T. Hopkinson, Royal Army Medical Corps.

The names of the undermentioned Officers, Non-commissioned Officers and Men are to be added to those brought to notice for distinguished and gallant services and devotion to duty by Lieut.-Gen. Sir W. R. Marshall, K.C.B., K.C.S.I., Commanding-in-Chief, Mesopotamian Expeditionary Force, in his despatch of February 7, 1919. Published in the Supplement of the *London Gazette*, dated June 5, 1919 (No. 31,386):—

ROYAL ARMY MEDICAL CORPS.

Temp. Capt. G. A. Back.
Temp. Capt. B. E. A. Batt, M.B.
Temp. Capt. N. G. Braham, M.C., F.R.C.S. Edin.
Temp. Capt. L. D. Callender.
Temp. Capt. A. L. Candler, M.B., F.R.C.S.
Temp. Capt. H. Findlay, M.B.
Capt. (Acting Major) J. F. Grant, M.B.
Temp. Capt. N. Gray, M.B.
Capt. (Temp. Major) T. J. Hallinan, M.B.
Temp. Capt. J. N. Lyons, M.D.
Temp. Capt. M. D. Mackenzie, M.B.
Temp. Capt. (Acting Lieut.-Col.) T. H. Martin, M.B.
Lieut.-Col. A. R. O'Flaherty.
Capt. A. B. Preston.
Capt. (Temp. Major) H. G. Robertson, M.B.
Temp. Capt. B. T. Saunders, M.B.
Temp. Capt. R. G. Smith.
Temp. Capt. P. Talbot, M.B., F.R.C.S.
Temp. Lieut. W. B. Vaile.
Temp. Capt. G. S. Woodman, M.B.
102118 Pte. (Acting Serjt.) J. M. D. Brown.
100810 Pte. C. Burton.
35519 Serjt. (Acting Qmr.-Serjt.) D. T. Crampton.
457176 Pte. (Acting Lance-Cpl.) G. S. Ellcock.
93590 Pte. J. G. M. Fletcher.
44344 Pte. F. Gelson.
72854 Pte. (Acting Serjt.) H. L. Hoff.
104207 Pte. L. Holden.
58492 Serjt. F. Philbey.
76498 Pte. B. H. Shepherd.
10423 Pte. C. Vane.
104801 Pte. (Acting Cpl.) W. S. Warburton.
104748 Pte. (Acting Cpl.) R. Whyte.

ROYAL ARMY MEDICAL CORPS (SPECIAL RESERVE).

Capt. A. B. Black.
Capt. I. Brawn.
Capt. (Acting Major) E. Butler.
Capt. (Acting Major) J. W. Cannon, M.B.
Capt. R. Colley, M.B.
Capt. W. H. Dye.
Lieut. W. M. Jones, M.B.
Capt. J. Le M. Kneebone, M.B.
Lieut. L. K. Ledger.
Capt. C. K. Mowll.
Capt. R. Rodger, M.B.

ROYAL ARMY MEDICAL CORPS (TERRITORIAL FORCE).

Capt. J. S. Hopwood, M.B.
Capt. (Acting Major) C. E. W. McDonald.
Capt. (Acting Major) A. Wilson, M.D.
461294 Serjt. L. Barrett, 3rd (Wessex) Field Ambulance.
27504 Pte. (Acting Cpl.) A. Flood, 1st (London) Sanitary Company.
464013 Lance-Cpl. W. H. Jenking, 100th Sanitary Section.
464003 Staff-Serjt. H. J. Karslake, 100th Sanitary Section.
545655 Cpl. W. H. Lewis, 46th Sanitary Section.
308039 Pte. J. G. McDonald, 1st Section General Hospital.
461055 Pte. H. W. Newby, 3rd (Wessex) Field Ambulance.

The names of the undermentioned Officers, Warrant Officers, Non-commissioned Officers and Men are to be added to those brought to notice for gallant conduct and distinguished services by Gen. Sir G. F. Milne, K.C.B., K.C.M.G., D.S.O., Commander-in-Chief, British Salonika Force, in his dispatch of March 9, 1919. (Published in the supplement of the *London Gazette*, dated June 5, 1919 (No. 31385)):—

ROYAL ARMY MEDICAL CORPS.

Temp. Capt. W. D. Cruickshank.
Temp. Capt. J. R. Davies.
Capt. (Acting Major) D. G. Stoute, M.B. (Special Reserve).
Temp. Capt. A. C. Sturrock.
134542 Pte. (Acting Lance-Serjt.) H. Askew.
79909 Pte. H. R. Baldwin.
106855 Cpl. H. Beacock.
83917 Staff-Serjt (Acting Serjt.-Major) W. J. Biddle.
112649 Pte. W. Blandford.
78809 Pte. J. H. Blyth.
22892 Pte. (Acting Cpl.) J. Boothroyde.
56755 Pte. (Acting Serjt.) J. Child.
23421 Pte. (Acting Lance-Cpl.) F. Cooling.
34054 Qmr.-Serjt. (Acting Serjt.-Major) J. Entwistle.
61045 Serjt. (Acting Qmr.-Serjt.) M. Farrell.
29529 Cpl. E. Lidster.
93088 Qmr.-Serjt. (Acting Serjt.-Major) J. W. McCawl
25245 Serjt. F. E. Moorse.
93677 Cpl. G. K. Reid.
25334 Staff-Serjt. (Acting Serjt.-Major) J. W. Shelmerdine.
2204 Pte. L. Shepherd.
8003 Staff-Serjt. T. J. Thomson.
54690 Pte. W. Walker.
9708 Pte. E. B. Walton.
5225 Staff-Serjt. W. T. Young.

ROYAL ARMY MEDICAL CORPS (TERRITORIAL FORCE).

Capt. L. B. Clarke.
Capt. G. Hardwike.
Capt. (Acting Major) I. Jones.
Capt. P. Seymour-Price.
Capt. G. G. Skinner.
390382 Serjt. W. S. Cook (Northumberland) Field Ambulance.
527472 Pte. (Acting Serjt.) H. V. Davis, 1st (London) Sanitary Company.
546094 Serjt. (Acting Staff-Serjt.) W. H. Draper, 2nd (London) Sanitary Company.
495171 Pte. E. B. George, 2nd (Home Counties) Field Ambulance.
495188 Pte. R. S. Giles, 2nd (Home Counties) Field Ambulance.
388242 Serjt. V. Mitchell (Northumberland) Field Ambulance.
388001 Qmr.-Serjt. W. Parker (Northumberland) Field Ambulance.
527373 Pte. (Acting Cpl.) F. Rose, 1st (London) Sanitary Company.
400102 Pte. A. K. Senior, 3rd (Home Counties) Field Ambulance.
425111 Pte. E. E. Smith, 2nd (Home Counties) Field Ambulance.
512011 Serjt. W. F. Taylor, 1/3rd (City of London) Field Ambulance.

AMENDMENTS TO MENTIONED IN DESPATCHES.

The undermentioned are now correctly described :—

France.

London Gazette, dated May 25, 1918 (No. 30704).—Capt. T. I. Dun, M.C., M.B., Royal Army Medical Corps (Special Reserve); Temp. Capt. L. C. Johnston, Royal Army Medical Corps, attd. 5th Cavalry Division.

London Gazette, dated July 10, 1919 (No. 31446).—Capt. (Acting Major) R. Ellis, M.B., 13th Casualty Clearing Station, Royal Army Medical Corps (Territorial Force); 6534 Cpl. (Acting Serjt.) R. W. Cathrine, Royal Army Medical Corps; 5132 Pte. G. H. McFarlane, Royal Army Medical Corps; 5614 Serjt. G. Reynolds, 5th Motor Ambulance Convoy, Royal Army Medical Corps.

East Africa.

London Gazette, dated June 5, 1919 (No. 31387).—6273 Cpl. H. A. H. Parnell, Royal Army Medical Corps.

Egypt.

London Gazette, dated January 22, 1919 (No. 31138).—18040 Staff Serjt. W. Tootlll, Royal Army Medical Corps; 5911 Serjt. (Temp. Staff-Serjt.) H. J. Howard, Royal Army Medical Corps.

Italy.

London Gazette, dated May 30, 1918 (No. 30711).—Major (Acting Lieut.-Col.) G. H. L. Hammerton, C.M.G., D.S.O., T.D., Yorks, Mounted Brigade Field Ambulance, Royal Army Medical Corps (Territorial Force).

Mesopotamia.

London Gazette, dated June 4, 1919 (No. 31386).—28173 Serjt. R. T. G. Bradley, Royal Army Medical Corps; 29533 Staff Serjt F. J. H. Martin, Royal Army Medical Corps; 25038 Qmr.-Serjt. H. Payne, Royal Army Medical Corps.

CENTRAL CHANCERY OF THE ORDER OF KNIGHTHOOD.

St. James's Palace, S.W. 1,
January 14, 1920.

The King has been graciously pleased to give orders for the following promotion in, and appointment to the Most Excellent Order of the British Empire, for valuable services rendered in connexion with military operations in Siberia. Dated June 3, 1919 :—

CANADIAN FORCES.

To be Commander of the Military Division of the said Most Excellent Order :—
Major (Temp. Col.) John Thomas Clarke, Canadian Army Medical Corps.

War Office,
January 14, 1920.

The name of the undermentioned has been brought to the notice of the Secretary of State for War for valuable and distinguished service rendered in connexion with Military Operations in Siberia. To be dated June 3, 1919 :—

146303 Cpl. F. G. London, Royal Army Medical Corps, formerly Garrison Battalion, Middlesex Regiment.

ISSUED WITH THE GAZETTE OF INDIA, EXTRAORDINARY, JULY 29, 1919.

The names of the undermentioned have been brought to the notice of the Government of India for valuable services rendered in India in connexion with the war up to December 31, 1919.

Col. H. M. Adamson, C.B., M.B., Army Medical Service.

Temp. Capt. D. D. Ritchie, Royal Army Medical Corps.

Capt. J. W. Tonks, Royal Army Medical Corps.

Major H. C. Winckworth, Royal Army Medical Corps.

MADRAS.

Major-Gen. T. M. Corker, C.B., Army Medical Service (retired), Ootacamund.

A. H. BINGLEY, *Major-General,*
Secretary to the Government of India.

ARMY MEDICAL SERVICE.

Major-Gen. Howard Carr, C.B., M.D., retires on retired pay, dated December 26, 1919.

Col. Francis W. Begbie, C.B.E., retires on retired pay, dated January 1, 1920.

Col. George Dansey-Browning, C.B.E., is placed on the half pay list, dated December 27, 1919.

The undermentioned Colonels from the half pay list retire on retired pay:—

Dated November 15, 1919.—Gerald T. Rawnsley, C.B., C.M.G.

Dated December 27, 1919.—Thomas B. Beach, C.M.G., C.B.E.

Major-Gen. Sir Henry N. Thompson, K.C.M.G., C.B., D.S.O., M.B., is placed on the half-pay list, dated November 18, 1919. (Substituted for the notification in the *Gazette* of December 8, 1919.)

ROYAL ARMY MEDICAL CORPS.

The undermentioned relinquish the acting rank of Lieutenant-Colonel on ceasing to be specially employed:—

Dated October 30, 1919.—Major Henry E. J. A. Howley.

Dated November 11, 1919.—Major Reginald V. Cowey, D.S.O.

The undermentioned to be acting Lieutenant-Colonels whilst specially employed:—

Dated October 30, 1919.—Major and Brevet Lieut.-Col. Charles R. Sylvester-Bradley.

Dated November 21, 1919.—Capt. and Brevet Major Francis T. Dowling.

Capt. Edward A. Strachan, M.B., relinquishes the acting rank of Major, dated December 16, 1918. (Substituted for the notification in the *Gazette* of March 13, 1919.)

The undermentioned relinquish the acting rank of Major on ceasing to be specially employed:—

Dated October 13, 1919.—Capt. Joseph A. L. Wilson, M.B.

Dated December 4, 1919.—Capt. John E. Hepper.

The undermentioned to be acting Majors whilst specially employed:—

Dated November 1, 1919.—Capt. William T. Graham, O.B.E., M.B.

Dated February 5 to July 23, 1919.—Capt. and Brevet Major William F. Christie, M.B.

Capt. Allan Watson, D.S.O., M.D., is seconded for service with the Egyptian Army, dated October 21, 1919.

Capt. Edward Claude Linton, from Special Reserve to be Captain, dated March 19, 1918, but not to reckon for pay or allowances prior to December 1, 1919, with precedence next below R. H. Leigh.

Lieut. (Temp. Capt.) Gerald E. Spicer, M.C., resigns his commission, dated December 20, 9191.

Major Montagu F. Grant, M.D., relinquishes the acting rank of Lieutenant-Colonel, dated March 23, 1919.

Capt. Joseph Charles Denvir, M.B., from T.F. to be Captain, dated November 4, 1918, but not to reckon for pay or allowances prior to December 1, 1919, with precedence next below W. Russell.

Lieut.-Col. Sydney G. Butler, D.S.O., relinquishes the acting rank of Colonel on ceasing to be specially employed, dated December 3, 1919.

Major Francis Casement, D.S.O., M.B., relinquishes the acting rank of Lieutenant-Colonel on ceasing to command a Medical Unit, dated January 23, 1919.

Lieut.-Col. Charles J. O'Gorman, D.S.O., to be Temporary Colonel whilst employed as A.D.M.S. of a Division, dated February 18, 1919. (Substituted for the notification in the *Gazette* of April 11, 1919.)

Lieut.-Col. C. J. O'Gorman, D.S.O., relinquishes the temporary rank of Colonel, dated March 31, 1919. (Substituted for the notification in the *Gazette* of November 4, 1919.)

Major William M. Power, from the half pay list, retires on retired pay on account of ill-health, dated October 5, 1919. (Substituted for the notification in the *Gazette* of October 4, 1919.)

Capt. Harold A. Rowell, M.C., relinquishes the acting rank of Major, dated March 31, 1919.

Major Edward L. Moss, C.M.G., M.C., relinquishes the acting rank of Colonel, dated November 16, 1919.

Major Gerald H. Stevenson, D.S.O., M.B., relinquishes the acting rank of Lieutenant-Colonel, dated November 21, 1919.

The undermentioned relinquish the acting rank of Lieutenant-Colonel :—
Dated March 15, 1919.—Major James H. R. Winder, D.S.O., M.D.
Dated March 27, 1919.—Major Charles W. Bowle, on ceasing to command a Medical Unit.
Dated May 12, 1919.—Major Ernest D. Caddell, M.C., M.B.
Dated October 15, 1919.—Capt. Ernest W. Wade, D.S.O., M.B.
Dated November 29, 1919.—Major Ernest G. Ffrench, M.D.Edin.
Dated December 11, 1919.—Major Robert W. D. Leslie, O.B.E.
The undermentioned Captains are seconded for service with the Egyptian Army :—
Dated December 1, 1919.—Brevet Major William E. Marshall, M.C., M.B.
Dated October 28, 1919.—James Biggam, M.C., M.B. (Substituted for the notification in the *Gazette* of December 9, 1919); Kenneth P. Mackenzie, M.B. (Substituted for the notification in the *Gazette* of November 8, 1919).

Major Ernest B. Lathbury, O.B.E., to be Acting Lieutenant-Colonel whilst commanding a Medical Unit from August 15 to October 5, 1919.

Capt. George S. Parkinson, D.S.O., to be Temporary Major whilst specially employed, dated November 6, 1919.

Temp. Capt. Eric Biddle, M.C., relinquishes the acting rank of Major, September 7, 1919. (Substituted for the notification in the *Gazette* of December 2, 1919.)

Capt. Harold A. Rowell, M.C., to be Acting Major from August 15 to October 5, 1919.

Temp. Capt. John Higgins to be Captain, dated March 1, 1918, but not to reckon for pay or allowances prior to November 1, 1919, with precedence next below A. L. Robertson. (Substituted for the notification in the *Gazette* of December 4, 1919.)

The undermentioned Lieutenants (Temporary Captains) to be Captains :—
Dated December 15, 1919.—Wilfred E. Hodgkins, M.B.
Dated December 19, 1919.—Thomas S. Law, M.B.

Lieut. Eric Henry William Elkington, from Canadian Army Medical Corps, to be Lieutenant, and to be Temporary Captain, April 17, 1918, but not to reckon for pay or allowances prior to December 15, 1919, with precedence next below M. C. Paterson.

Capt. John S. McCombe, D.S.O., M.B., relinquishes the acting rank of Major, dated November 11, 1919.

Capt. and Brevet Major James D. Kidd, O.B.E., M.C., M.B., to be Acting Major, dated November 12, 1919.

Major Frederick E. Rowan Robinson, M.B., relinquishes the acting rank of Lieutenant-Colonel, dated December 18, 1919.

Major Clarence H. Denyer, M.C., to be Acting Lieutenant-Colonel from September 25 to November 19, 1919.

Capt. Lionel C. Hayes to be Temporary Major whilst specially employed, dated September 16, 1919.

The undermentioned Captains relinquish the acting rank of Major :—
Dated March 31, 1919.—William T. Hare, M.C.; William K. Campbell, D.S.O., M.C., M.B.
Dated December 1, 1919.—Albert Jackson.
Dated December 16, 1919.—Ernest C. Lambkin, D.S.O., M.B.
Dated December 22, 1919.—John F. Bourke, M.C.

Major Ernest G. R. Lithgow is restored to the establishment, dated January 1, 1920.

Capt. Philip H. Wells, M.C., relinquishes his commission, dated January 13, 1920.

Capt. Thomas Edward Bellingham Beatty, from Special Reserve, to be Captain, dated August 16, 1919, but not to reckon for pay or allowances prior to December 9, 1919, with precedence next below W. L. A. Harrison.

Lieut.-Col. Denis J. Collins to be Temporary Colonel whilst Assistant Director of Medical Services, dated April 7, 1916. (Substituted for the notification in the *Gazette* of July 14, 1916.)

The notification in the *Gazette* of November 4, 1919, and the substitution therefor in the *Gazette* of December 30, 1919, regarding Lieut.-Col. Charles J. O'Gorman, D.S.O., are cancelled.

ROYAL ARMY MEDICAL CORPS FUND.

PROCEEDINGS OF A COMMITTEE MEETING OF THE ROYAL ARMY MEDICAL CORPS FUND HELD AT CORNWALL HOUSE, WAR OFFICE, ON WEDNESDAY, JANUARY 21, 1920, AT 2.30 P.M.

Present.

Lieut.-Gen. Sir T. H. J. C. Goodwin, K.C.B., C.M.G., D.S.O., K.H.S., Director-General, in the chair.
Major-Gen. Sir G. B. Stanistreet, K.B.E., C.B., C.M.G., Deputy Director-General.
Major-Gen. Sir W. Donovan, K.C.B.
Col. Sir James Magill, K.C.B.
Col. C. R. Tyrrell, C.B., C.B.E.
Lieut.-Col. A. B. Cottell.
Major P. G. Easton, C.B.E., D.S.O.
Major E. P. Offord.

(1) The minutes of the meeting held on October 9, 1919, were read and confirmed.

(2) Letters of regret for absence were read from Col. H. A. Hinge, Commandant of the Royal Army Medical College, and from Capt. E. B. Allnutt, Band President.

(3) *Memorials.*—The Secretary reported payment of cheque of £100 on account to artist for memorial to certain distinguished officers, and also read further letter in which it was hoped that the memorial would be finished in a few weeks.

(4) *Band.*—The accounts of the Band President for the quarter ending December 31, 1919, were submitted and approved, and authority given for the payment of £100 if and when necessary.

(5) The Secretary reported action taken in the case of the widow and orphan of the late W.C., which had been brought forward by the Director-General at the last meeting. This case had been transferred to the Royal Army Medical Corps Benevolent Society, and a grant of £30 paid to the orphan.

(6) The Secretary reported payment of cheque of £114 14s. 6d. to the Commandant of the Royal Army Medical College as directed at the last meeting, and also the purchase of a copy of Col. W. Johnston's "Roll of the Corps."

(7) *General Relief.*—Nine small grants amounting to £31 which had been made under Rule 9 were reported and approved.

(8) The following fresh applications for assistance were considered, and grants approved as stated against the initials :—

Mrs. E. B., old age and poverty	£6	0	0
Mr. A. T., assistance in paying rent	3	0	0
Mr. and Mrs. E. G., both in ill-health	3	0	0
Mrs. K. H., permanent ill-health	3	0	0
Mrs. A. M. B., to assist with children	3	0	0
Mr. M. K. Q., permanent ill-health	6	0	0
Mrs. L. E. S., old age and debility	2	0	0
Mrs. E. E., ill-health..	3	0	0
One application was refused			
	£29	0	0

(9) The following donations have been received since the last meeting :—

90th Field Ambulance, per Major T. L. Fennell	£48	15	0
Col. H. C. Sidgwick, 12th Casualty Clearing Station	7	11	5
Capt. E. Vaughan, 23rd Field Ambulance	7	19	1
R.A.M.C. Depot, Deolali, India	68	15	0
106th Field Ambulance	36	3	10*
No. 2 General Hospital	15	19	9
18th Field Ambulance	16	3	0*
104th Field Ambulance	14	3	4*
53rd Stationary Hospital, Archangel	34	10	0
No. 4 Stationary Hospital	17	0	0
No. 53 Stationary Hospital	20	0	0
Serjeants' Mess, R.A.M.C. Records, France	2	3	0
51st General Hospital	3	13	3
No. 1 Field Ambulance	18	0	0
Part of Balance of P.O.W. Fund	245	13	4
42nd Stationary Hospital	15	2	0
10th Corps Troops, France	49	10	0*
Military War Hospital, Belfast	24	4	0
4th General Hospital, Dunkirk..	5	11	4
	£650	17	9

* Sums allotted to this Fund of larger cheques received, balance having been alloted to other Funds.

(10) The Secretary reported the purchase of £630 12s. 11d. War Stock for £600 as directed by the last meeting, and it was decided to invest a further sum of £600 in Government Securities after consultation with Messrs. Holt and Co.

(11) *Schools.*—An application from an Ex-N.C.O. of the Corps for assistance in the education of his daughter was considered, and the Secretary was directed to make further inquiries. If the result proves to be satisfactory payment up to the amount of 5s. a week was sanctioned for a period of six months.

Sanction was also given to transfer the amount of £100 on deposit to the current account when necessary.

(12) *Dinner.*—The Report of the Dinner Sub-Committee held on January 20, was read, considered and approved as follows :—

REPORT OF DINNER SUB-COMMITTEE.

Present.

Col. C. R. Tyrrell, C.B., C.B.E.
Col. J. R. McMunn, C.B., C.M.G.
Lieut.-Col. E. M. Wilson.
Col. J. A. Hartigan, C.M.G., D.S.O., representing Aldershot.
Major F. A. Stephen, representing Netley.
Major H. S. Dixon, representing Woolwich

(i) Col. C. R. Tyrrell, C.B., C.B.E., was elected Chairman.

(ii) The Committee recommended that the date of the Dinner should be Monday in Ascot week if possible, and that the place should he left to a Sub-Committee to be appointed.

(iii) The accounts were examined and postponed owing to the temporary absence of the Hon. Secretary.

(iv) The Committee considered tho question of guests, and recommended that the Corps should revert to its former practice of inviting no guests except Mr. V. G. Holt.

(*a*) That the Band President be asked to provide a small number of selected musicians.

(*b*) That the Messes be asked to lend part of their plate as in previous years.

(*c*) That the dress should be evening dress with miniature decorations.

(*d*) That all subscribers to the Corps Fund shall be entitled to dine at the rate of 7s. 6d., and that non-subscribing officers of the Regular Royal Army Medical Corps who wish to attend may do so at an additional charge of 2s. 6d. over and above the amount fixed by the Hotel.

(*e*) A Sub-Committee was appointed as follows to carry out all details :—

Col. C. R. Tyrrell, C.B., C.B.E.
Col. J. R. McMunn, C.B., C.M.G.
Col. J. A. Hartigan, C.M.G., D.S.O.
Lieut.-Col. E. M. Wilson.
Capt. A. R. Wright, D.S.O.

(13) The Secretary informed the Committee that his tenure of the office in Victoria Street had been terminated by the landlords and that in consequence he had been obliged to take another office at 76, Claverton Street, at an increased rent. This and the cost of removal had entailed additional expenditure amounting to £20, and he asked whether the Committee, acting in conjunction with the Benevolent Fund, would kindly sanction a grant towards payment of this amount.

The matter was discussed and, subject to the agreement of the Committee of the Benevolent Society, it was decided unanimously that the Secretary's salary should be raised to £200 a year and that the Funds would pay all necessary office expenses supported by satisfactory vouchers.

The Royal Army Medical Corps Fund (Officers Branch) and the General Relief Branch will each continue to pay one third of the total expenditure, and the Royal Army Medical Corps Benevolent Society the remaining third according to the existing agreement approved by the General Annual Meeting held on June 11, 1917.

This decision is to take effect from January, 1920, provided it is approved by the Annual General Meeting to be held in June next.

E. M. WILSON, *Lieut.-Col.*
Secretary.

ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT CORNWALL HOUSE, WAR OFFICE, ON WEDNESDAY, JANUARY 21, 1920, AT 3.30 P.M.

Present.

Lieut.-Gen. Sir T. H. J. C. Goodwin, K.C.B., C.M.G., D.S.O., K.H.S., Director-General, in the Chair.
Major-Gen. Sir W. Donovan, K.C.B., one of the Trustees.
Major-Gen. Sir M. W. Russell, K.C.M.G., C.B.
Major-Gen. Sir H. R. Whitehead, K.C.B.
Col. A. Peterkin, C.B.
Col. H. W. Murray.
Col. C. K. Morgan, C.B., C.M.G.
Capt. J. T. Clapham.

(1) The Minutes of the meeting held on October 9, 1919, and the special meeting held on November 3, were read and confirmed.

(2) The Secretary reported action taken by direction of the Committee in connexion with the letter received from the Field-Marshal Commanding the Home Forces.

(3) Also action taken in the cases of (1) the widow and orphans of the late A. W., (2) M. P. F. and (3) M. E. C. C., brought forward by the Director-General. This last case has been transferred from the Royal Army Medical Corps Fund, and a grant of £30 made—approved.

(4) Three grants made under Rule 31 were submitted and approved. The Secretary suggested that in consequence of the increased cost of living and the present diminution of the value of money this rule might be amended so as to empower the Secretary to give somewhat larger amounts in cases of immediate necessity. After discussion it was decided that the words "not exceeding £25 a quarter" be altered to read "not exceeding £50 a quarter," subject to the approval of the next Annual General Meeting.

(5) Five fresh cases were submitted under Rule 24 and grants authorized as follows:—

	£	s.	d.
The orphans of the late A. W. (subject to the receipt of the necessary particulars) ..	10	0	0
The orphans of the late T. L. J.	20	0	0
The orphan of the late W. H.	20	0	0
The orphan of the late J. F.	10	0	0
The orphans of the late V. H. S.	20	0	0
Total	£80	0	0

(6) The Secretary reported that up to the present time sixty-six additional officers have subscribed to the Fund in consequence of the appeal sent out by the Committee in connexion with the centenary of the Society, and that the expenses of printing and postage amounted to £6 4s. 6d.

(7) The following donations have been received since the last meeting:—

84th General Hospital, East Africa	£31	3	5
Nos. 4 and 53, Stationary Hospitals	10	15	0

These are the net amounts received by the Society, being parts of larger cheques, the balance of which have been transferred to other Funds according to the wishes of the donors.

(8) The Secretary read a communication from solicitors in Scotland regarding a bequest which will eventually accrue to the Society, and was directed to reply that the Committee would prefer to wait until the estate is finally wound up.

(9) The Secretary reported that the stock of blue application forms for assistance was nearly exhausted, and a Sub-Committee was appointed to consider whether any alterations are advisable in this form prior to printing a fresh supply. The Sub-Committee to consist of Major-Gen. Sir M. W. Russell, Capt. J. T. Clapham and the Secretary, with power to decide.

(10) It was decided that the Secretary should send out the application forms to orphans to whom grants have previously been made as was done last year, accompanied in each case by a letter explaining that this action was not to be regarded as a guarantee that a grant would be authorized.

(11) The Committee considered the proposal of the Royal Army Medical Corps Fund Committee regarding an increase of the Secretary's salary as contained in para. 13 of the proceedings of that Committee, viz., that the Secretary's salary should be raised to £200 a year, and that the Funds would pay all necessary office expenses supported by satisfactory vouchers, and it was proposed by Major-Gen. Sir M. W. Russell and seconded by Major-Gen. Sir H. R. Whitehead and carried unanimously to agree with the recommendation subject to the approval of the next Annual General Meeting.

E. M. WILSON, *Lieut.-Col.*,
Secretary.

76, *Claverton Street*, *S.W.* 1.

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

THE following letter has been sent to officers of the Corps by the Chairman of the Committee of the Royal Central Mess Fund, and is published for general information:—

DEAR SIR,—The Committee desire to bring to your notice the existence of the Royal Army Medical Corps Central Mess Fund.

The general functions of the Fund are to help in the proper upkeep of the permanent Messes of the Corps, by means of both money grants and loans, and to give grants to make the initial outlay required to provide camp mess kit in Commands and Districts for the use of Medical Units taking part in manœuvres, etc.

During the past five years the Fund has been of special assistance to the Messes which were hard hit by war conditions. More than £1,400 has already been paid to Messes in grants and loans during the current year.

The personal advantages to officers subscribing to the Fund are that they are relieved of the payment of all joining contributions, and further promotion contributions, to permanent Messes, such contributions being paid by the Fund.

At present the permanent R.A.M.C. Messes are located in London, Aldershot, Netley, Woolwich, Curragh Camp, Cosham and at the R.A.M.C. Depot, Tweseldown Camp, Aldershot; in

India, at Bangalore, Lucknow, Peshawar and Rawal Pindi. As the joining contributions to these vary from two to four days' pay at home, and somewhat less in India, it is obvious that there is a great financial advantage in becoming a subscriber to the Fund at once, more especially when it is realized that all officers joining the Corps in normal times have to join the Mess at both Millbank and Tweseldown Camp, after which they are liable to be posted to one of the other large stations with a Mess.

The Committee consider that as the Central Mess Fund is now an established institution of the Corps, it is most desirable that it should have your support. Before the war, four-fifths of the officers of the Corps subscribed to it. Notices have been sent out from time to time, to all those who have joined since, but in many cases no doubt these have not reached them. I would point out that officers frequently complain that they have not been acquainted with the benefit acquired by joining the Fund; I trust, therefore, that you will not disregard this letter, and that if you wish further particulars you will write at once to the Hon. Secretary, R.A.M.C. Central Mess Fund, Capt. J. T. Clapham, 3. Homefield Road, Wimbledon, London, S.W. 19.

Should you desire to become a subscriber to the Fund, would you kindly complete the enclosed banker's order and send it direct to your agents.

In case you may have already paid a joining contribution to any of the above-mentioned Messes, the sum so paid should be deducted from the entrance fee mentioned on the order, and an explanatory note sent to the Hon. Secretary addressed as above.

R.A.M.C. Depot,
Tweseldown Camp,
near Aldershot.,
December, 1919.

Yours faithfully,
P. Davidson, *Lieut. Col.*,
Chairman of Committee,
R.A.M.C. Central Mess Fund.

ROYAL ARMY MEDICAL CORPS PRISONERS OF WAR FUND.

The Honorary Treasurer has great pleasure in submitting at last the statement of accounts for the years 1918-1919 and final closure of the Fund.

The accounts were practically completed and audited in May last, but it was found necessary to keep the books open as small remittances were still coming in and certain cheques were then outstanding.

It was also necessary to obtain the sanction of the Charity Commissioners, under the War Charities' Act of 1916, and satisfy the Commissioners and the Clerk of the County Council as to their accuracy and the proposed distribution of the credit balance. The last letter notifying approval has been received to-day.

We have also received grateful letters of thanks from the Auxiliary Royal Army Medical Corps Fund and the General Relief Branch of the Royal Army Medical Corps Fund, for the handsome donations.

The Honorary Treasurer hopes that all the generous subscribers to this Fund will approve of the distribution.

Commencing in 1915 as the Comforts Fund it gradually developed enormously and in the latter years of the War was devoted entirely to the relief of the Prisoners of War of our own Corps. Owing to the untiring and continuous efforts of our Ladies Committee our men in that unfortunate position were maintained in comparative comfort, and countless letters were received from them and their relatives, besides many personal visits, expressing their thanks for all that had been done on their behalf.

Former notices of the Fund appeared in Corps News of March and May, 1919.

76, *Claverton Street, S.W.* 1.
January 10, 1920.

E. M. Wilson,
Honorary Treasurer.

STATEMENT OF ACCOUNTS OF THE ROYAL ARMY MEDICAL CORPS PRISONERS OF WAR FUND, 1918-19.

RECEIPTS.

	£ s. d.	£ s. d.
To Balance in hand December 31, 1917		623 17 2
Grants and Donations from Individual Officers	£1,433 13 0	
Units at Home and Abroad, including Officers	23,338 14 1	
		24,772 7 1
Amount realized by Stores left on hand		790 2 6
,, ,, Sale of Addressograph		14 0 0
Interest on Deposit Account		6 18 1
Sale of Treasury Bills		1,983 18 8
		£28,191 3 6

EXPENDITURE.

	£ s. d.	£ s. d.
By Addressograph Co.	49 3 2	
Army and Navy Stores*	355 6 5	
Blackburn P.O.W. Fund	30 14 0	
Central P.O.W. Committee	23,103 16 2	
Comité Internationale de la Croix Rouge	34 0 0	
Customs and Excise	320 8 11	
Messrs. Dray & Sons	170 14 8	
Empire Service	27 0 0	
Messrs. Gamage	22 10 0	
Messrs. Lakeman	4 15 0	
Martin's Tobacco	6 15 0	
Messrs. Morton	24 16 5	
News of the World	7 17 5	
North Hants' Printing Co.	125 9 8	
Oxo Ltd.	21 12 0	
Portsmouth P.O.W. Fund	32 19 6	
Poulter & Sons	17 2 6	
Messrs. Swainston	590 14 6	
Walker's Tobacco Trust	69 8 4	
Office Expenses: Salaries, Postage, etc.	317 14 5	
Charge for Circulars to Officers, Stamping Banker's Order Forms, Cheques and Cheque Books	48 15 7	
Bills, total		25,382 3 8
Transferred to R.A.M.C. Auxiliary Fund		82 15 8
Paid Bank of England for £2,000 Treasury Bills and Banker's Charges		1,964 19 2
Unpaid Drafts		5 11 6
Refund of Unused Subscription—Mrs. Varndin		5 0 0
Refund of Unexpended Balance Railway Clearing House		29 10 3
Amount credited in Error		3 18 5
		£27,473 18 8
Balance as per Pass Book	£715 13 9	
Petty Cash in hand	1 11 1	
		717 4 10
		£28,191 3 6

**Outstanding Cheques to be brought to Account.*

Army and Navy Stores	£1 4 3
American Red Cross Society	2 1 10

May 2, 1919.

Audited and found correct.
EDMOND T. GANN.

E. M. WILSON, *Lieut.-Col.*,
Hon. Treasurer.

ROYAL ARMY MEDICAL CORPS PRISONERS OF WAR FUND.

Credit.	£	s.	d.	Debit.	£	s.	d.
Balance brought forward, May 2	717	4	10	Outstanding Cheques now brought to Account and Additional Postage	3	10	7½
Since received from Units at Home and Abroad and Refund of Remittances	23	12	10	Balance distributed :—*			
				Two-thirds to Auxiliary R.A.M.C. Fund	491	6	8
				One-third to R.A.M.C. General Relief Fund ..	245	13	4
				Balance Petty Cash in hand	0	7	0½
	£740	17	8		£740	17	8

* This distribution was authorized by the Committee and has been approved by the Charity Commissioners.

December 12, 1919.

Audited and found correct.
EDMOND T. GANN.

E. M. Wilson, *Lieut.-Col.*,
Hon. Treasurer.

ROYAL ARMY MEDICAL COLLEGE.

LIST OF BOOKS ADDED TO THE LIBRARY DURING THE MONTHS OF OCTOBER, NOVEMBER AND DECEMBER, 1919.

Title of Work and Author	Edition	Date	How obtained
A Stereoscopic Atlas of Plastic Surgery of the Face, Head and Neck. By Joseph C. Beck, M.D., and Ira Frank, M.D.		1919	Library Grant.
Physiology and Bio-Chemistry in Modern Medicine. By J. J. R. MacLeod, M.B.		1919	,, ,,
Everyman's Chemistry. By Elwood Hendrick		1919	,, ,,
Clinical Methods. By Hutchison and Rainy	6th	1919	,, ,,
The Practitioner's Manual of Venereal Diseases. By A. C. Magain, M.D.		1919	,, ,,
Anaphylaxis and Anti-Anaphylaxis. By Dr. A. Besredka. English Translation by S. R. Gloyne, M.D.		1919	,, ,,
The Medical Directory		1919	,, ,,
Collected Papers of the Mayo Clinic. Vol. x, 1918 ..		1919	,, ,,
A Manual of Tropical Medicine. By Castellani and Chalmers	3rd	1919	,, ,,
A Dictionary of Treatment. By Sir William Whittle, M.A., M.D.	6th	1920	,, ,,
Industrial Poisoning. By Dr. J. Rambousek. Translated and edited by T. M. Legge, M.D.		1913	,, ,,
Allen's Commercial Organic Analysis. Vol. ix	4th	1917	,, ,,
Rural Water Supplies and their Purification. By A. C. Houston, M.B., B.Sc.		1918	,, ,,
Stoichiometry. By Sydney Young, D.Sc., F.R.S. ..	2nd	1918	,, ,,
Organic Chemistry for Students of Medicine. By James Walker, F.R.S.	2nd	1919	,, ,,
The Future of Medicine. By Sir James MacKenzie, F.R.S., M.D.		1919	,, ,,
A Vision of the Possible: what the R.A.M.C. might become. By Sir James W. Barrett, K.B.E., C.M.G., M.D.		1919	,, ,,
Practical Vaccine Treatment for the General Practitioner. By R. W. Allen, M.A., M.D.		1919	,, ,,
Knight's Annotated Model By-Laws. Edited and Revised by William A. Casson	7th	1905	,, ,,
The Pathology of Pneumonia in the United States Army Camps during the Winter of 1917-18. By W. G. MacCallum, M.D.		1919	,, ,,
Abstracts of War Surgery. Published since 1914 ..		1918	,, ,,
Practical Physiological Chemistry. By Sydney W. Cole, M.A.	5th	1919	,, ,,
The Lister Institute of Preventive Medicine: Report of the Governing Body, 1919		1919	,, ,,
Medical Science Abstracts and Reviews. Vol. i. Nos. 1 to 3. October to December, 1919		1919	,, ,,
Mosquito Control in Panama. By Le Prince and Orinstein		1916	,, ,,
Forty Days in 1914. By Major-General Sir F. Maurice, K.C.M.G., C.B.		1919	,, ,,
The Marne Campaign. By Major F. E. Whitton.. ..		1917	,, ,,
Chronology of the War. Vol. i, 1914-15		1918	,, ,,
The Surgery of Egypt. By F. C. Madden, O.B.E., M.D., F.R.C.S.		1919	Editor, Journal.
The Intensive Treatment of Syphilis and Locomotor Ataxia by Aachen Methods. By R. Hayes, M.R.C.S.	3rd	1919	,, ,,

LIST OF BOOKS ADDED TO THE LIBRARY—*Continued.*

Title of Work and Author	Edition	Date	How obtained
Venereal Diseases. By Browning and Watson		1919	Editor, Journal.
A Preliminary Report on Malarial Conditions in Syria, Palestine and the Adjoining Provinces. April, May and June		1919	,, ,,
On Facial Neuralgia and its Treatment. By J. Hutchinson, F.R.C.S.		1919	,, ,,
Traitement des Lésions des Nerfs. Par Mme. Athanassio-Benisty		1919	,, ,,
William Howard Lister. By Walter Seton. With a Foreword by Lieut.-General Sir Ivor Maxse, K.C.B., C.V.O., D.S.O.		1919	,, ,,
London County Council. Archives of Neurology and Psychiatry from the Pathological Laboratory of the London County Mental Hospitals. Vol. vii. Edited by F. W. Mott, M.D., LL.D., F.R.S.		1918	,, ,,
New South Wales. Report of the Director-General of Public Health for the year ended December 31, 1917		1919	,, ,,
Eighth Report of the Microbiological Laboratory (Government Bureau of Microbiology) for the year 1917		1919	,, ,,
Elementary Organic Chemistry, adapted for the Use of Pharmaceutical and Medical Students. By F. P. Sargeant	2nd	1919	,, ,,
Handbook for the Women's Royal Air Force		1919	,, ,,
Pye's Elementary Bandaging and Surgical Dressing. Revised by V. Zachary Cope, B.A., M.D.	14th	1919	,, ,,
Anæsthesia and the Nurse's Duties. By A. de Prenderville		1919	,, ,,
Chronic Traumatic Osteomyelitis. By J. Renfrew-White, M.B.		1919	,, ,,
The Epidemics of Mauritius. By D. E. Anderson ..		1918	,, ,,
Collected Papers from the Research Laboratory, Parke, Davis and Co., Detroit, Mich. Dr. E. M. Houghton, Director. Reprints, vol. v, 1917, and vol. vi, 1919		1917-19	,, ,,
Rural Sanitation in the Tropics. By Malcolm Watson, M.D.		1915	,, ,,
The Sex Complex. By W. Blair Bell, M.D.		1916	,, ,,
Income Tax for Service Men. By Lieut. A. F. Stevenson		1918	,, ,,
Principles of General Physiology. By W. M. Bayliss, F.R.S.	2nd	1918	,, ,,
Diseases of the Heart. By F. W. Price, M.D., F.R.S.		1918	,, ,,
Manual of Medicine. By T. K. Monro, M.A., M.D. ..	4th	1917	,, ,,
The Fitting-out and Administration of a Naval Hospital Ship. By Fleet Surgeon E. Sutton, R.N.		1918	,, ,,
Lessons on Massage. By Margaret D. Palmer	5th	1918	,, ,,
Surgical Nursing and After-Treatment. By H. C. Rutherford Darling, M.D.		1917	,, ,,
War Story of the C.A.M.C., Vol. i. By Col. J. G. Adami, M.D., F.R.S., C.A.M.C.		1918	,, ,,
The Maintenance of Health in the Tropics. By W. J. Simpson, C.M.G., M.D.	2nd	1916	,, ,,
Burns and their Treatment. By J. M. H. MacLeod, M.A., M.D.		1918	,, ,,
Extra-Ocular Pressure and Myopia. By Islay B. Muirhead, M.D.		1916	,, ,,
An Index of Symptoms. By R. W. Leftwich, M.D. ..	6th	1917	,, ,,
Dangers in Neck-wear. By W. G. Walford, M.D. ..		1917	,, ,,
Clinical Case-Taking. By R. D. Keith, M.A., M.D. ..		1918	,, ,,
Physical and Occupational Re-Education of the Maimed. By Jean Camus. Translated by W. F. Castle		1918	,, ,,
A System of Hand and Finger Re-Education. By Capt. C. W. Sewell, M.C.		1917	,, ,,

LIST OF BOOKS ADDED TO THE LIBRARY—*Continued.*

Title of Work and Author	Edition	Date	How obtained
The Early Diagnosis of Tubercle. By Clive Riviere, M.D.	2nd	1919	Editor, Journal.
On Gunshot Injuries to the Blood-Vessels. By Sir George Makins, G.C.M.G., C.B.		1919	,, ,,
Aids to the Use of Maps Employed by the English, French, Belgian and German Armies. By T. Drew		1918	,, ,,
The War Work of the Y.M.C.A. in Egypt. By Sir James W. Barrett, K.B.E., &c.		1919	,, ,,
National Health Insurance. Fifth Annual Report of the Medical Research Committee, 1918-1919		1919	Medical Research Committee.
Annual Report of Dispensaries in the North-West Frontier Province for the year 1918		1919	India Office
Report on Vaccination in the North-West Frontier Province for the year 1918-1919. By Major H. Crossle, M.D., I.M.S.		1919	,, ,,
Annual Report of the Sanitary Commissioner with the Government of India for 1917		1919	,, ,,
Chest Radiography at a Casualty Clearing Station. By R. Lindsay Rea, B.Sc., M.B.		1919	War Office.
Naval and Military Despatches relating to Operations in the War :—			
Part 7 (published in the *London Gazette*, December, 1916, to July, 1917). With names of Officers and men awarded the Victoria Cross		1918	,, ,,
Part 8 (published in the *London Gazette*, July, 1917, to June, 1918)		1919	,, ,,
The British Guiana Medical Annual for 1919. Edited by F. G. Rose, B.A., M.A.		1919	The Editor.
Journal of the Royal Naval Medical Service, October, Vol. v, No. 4		1919	,, ,,
British Medical Association, Special Clinical and Scientific Meetings, London, 8th—11th, 1919. Proceedings		1919	The Financial Secretary and Business Manager.
The Japan Medical World. August 24 to November 2 ..		1919	The Director.
The Medical Officer, October 4, to September 20		1919	The Editor.
The Geographical Journal, August, September, October, and November, 1919		1919	Presented by Col. R. J. S. Simpson, C.B.,C.M.G.,A.M.S.
Records of Receipts and Issues of Medicine, at the Highland Division, Crimea War. By W. Henry Richardson, Medical Staff, Highland Division, Camp at Kamara, Crimea, January 31, 1855			Presented by C. H. Collingwood Richardson, Esq.
Illustrations of the Great Operations of Surgery. By Charles Bell		1821	Presented by Col. P. Evans, C.M.G., A.M.S.
Proceedings of the Medical Conference held at the Invitation of the Committee of the Red Cross Societies, Cannes, France, April 1 to 11, 1919		1919	Presented by Dr. R. P. Strong, General Medical Director.
Archives de Médecine et de Pharmacie Militaires. Vol. lxviii, Nos. 1, 2 and 3, vol. lxix, Nos. 1 and 2		1917-18	Presented by Col. S. L. Cummins, C.B.,C.M.G.,A.M.S.
Man: A Monthly Record of Anthropological Science, December, 1918, to December, 1919		1918-19	,, ,,
The Journal of the Royal Anthropological Institute of Great Britain and Ireland :—			
Vol. xlviii, July to December, 1918		1918	
Vol. xlix, January to June, 1919		1919	,, ,,
Surgical Observations. Part 2, containing An Account of the Disorders of the Health in General. By John Abernethy		1806	Presented by Lieut.-Col. E. M. Wilson, C.B.,C.M.G.,D.S.O., R.A.M.C. (Ret.).

LIST OF BOOKS ADDED TO THE LIBRARY—*Continued.*

Title of Work and Author	Edition	Date	How obtained
Surgical Observations on Injuries of the Head; and Miscellaneous Subjects. By John Abernethy		1810	Presented by Lieut.-Col. E. M. Wilson, C.B., C.M.G., D.S.O., R.A.M.C. (Ret.).
Observations on the Nature and Cure of Glandular Diseases, especially those denominated Cancer. By Sir Charles Aldis	2nd	1821	,, ,,
The Morbid Anatomy of some of the most Important Parts of the Human Body. By Matthew Baillie	3rd	1807	,, ,,
A System of Dissections. Vol. i. By Charles Bell ..	3rd	1809	,, ,,
Discourses on the Nature and Cure of Wounds. By John Bell	3rd	1812	,, ,,
An Inquiry into the Anti-Variolous Power of Vaccination. By Thomas Bowen		1809	,, ,,
Practical Observations on the Inoculation of Cowpox. By James Bryce	2nd	1809	,, ,,
A. Com. Celsus. Medicina libri Octo ex rec. L. Targæ ..		1815	,, ,,
Observations on Pulmonary Consumption. By A. Duncan, Sen.	2nd	1816	,, ,,
On Morbid and Curative Effects of Loss of Blood. By Marshall Hall		1830	,, ,,
A Treatise on the Scurvy. By James Lind	2nd	1757	,, ,,
An Elementary Compendium of Physiology. By F. Magendie. Translated by E. Milligan		1823	
A Treatise on the Structure, Economy and Diseases of the Liver. By William Saunders	2nd	1795	,, ,,
A Treatise on Experience in Physic. Vol. i. By Dr. Zimmermann		1782	,, ,,
The Edinburgh Medical and Surgical Journal. Vols. x to xiii, and vol. xv		1814-19	,, ,,
Organisation et Fonctionnement du Service de Santé. Par M. Cousergue		1913	Presented by Col. C. H. Melville, C.M.G., A.M.S.
L'Allègement du Fantassin et l'Amélioration de sa Subsistance en Campagne		1905	,, ,,
Comment on Marche. Par M. M. Regnault and Raoul ..			,, ,,
L'Education Physique, son influence sur la Santé du Soldat. Par le Dr. Ch. Daussat		1910	,, ,,
La Marche considérée comme Exercice de Développement Physique			,, ,,
Les Grandes Marches d'Armée. Par Général H. Bonnal ..		1911	,, ,,
L'Equipement et la Charge de l'Infanterie			,, ,,
Petit Manuel illustré du Soldat		1912	,, ,,
Manuel d'Instruction Militaire		1912	,, ,,
Les Problèmes de la Sexualité. Par Maurice Caullery ..		1913	,, ,,
Regolamento di Esercizi per la Fanteria		1907	,, ,,
Feld-Taschenbuch für K. und K. Militar-Ärzte. Von Regimensarzt. Dr. Karl Crou		1897	,, ,,
Turnvorschrift für die K. u. K. Fuzstruppen		1903	,, ,,
A Clinical Handbook of Urine Analysis. By C. H. Bedford	2nd	1904	Presented by Col. J. C. B. Statham, C.M.G., C.B.E., A.M.S.
On Disorders of Assimilation, Digestion, etc. By Sir T. Lauder Brunton		1904	,, ,,
Text-Book of Physiological and Pathological Chemistry. By G. Bunge. Second English Edition		1902	,, ,,
Military Hygiene. By Lieut.-Col. R. Caldwell, R.A.M.C.		1905	,, ,,
Précis de Chimie Analytique. Par G. Denigès		1903	,, ,,
La Chimie de la Celluse Vivante. Par A. Gautier ..	2nd	1898	,, ,,
Urines Dépots-Sédiments Calculs. Par E. Gautrelet ..		1889	,, ,,

LIST OF BOOKS ADDED TO THE LIBRARY—*Continued.*

Title of Work and Author	Edition	Date	How obtained
Spectroscopic Critique des Pigments Urinaires Normaux. Par E. Gautrelet		1900	Presented by Col. J. C. B. Statham, C.M.G., C.B.E., A.M.S.
Traité des Urines. L'Analyse des Urines. Par Dr. E. Gérard		1903	,, ,,
Les Fonctions Hépatiques. Par M. M. Gilbert and Carnot		1902	,, ,,
Lectures on Chemical Pathology. By C. A. Hester ..		1902	,, ,,
Physiology and Pathology of the Urine. By J. Dixon Mann		1904	,, ,,
Guide Pratique pour l'Analyse des Urines. Par Gustave Mercier		1901	,, ,,
Practical Analysis and Urinary Diagnosis. By C. W. Purdy	5th	1900	,, ,,
L'Urine Humaine. Par C. Vieillard		1898	,, ,,
Essai de Sémiologie Urinaire. Par C. Vieillard		1901	,, ,,
Medizinal-Berichte über du Deutschen Schutzgebiete ...		1911	,, ,,
Union of South Africa. Report of the Government Veterinary Bacteriologist for the year 1909-1910		1911	,, ,,
Yellow Fever Commission West Africa. 2nd, 3rd and 4th Reports		1915-17	,, ,,
Mikroskop Technik und Diagnostik in du Gynakolog Praxis. Von Dr. Karl Abel		1895	Presented by Capt. R. H. A. Plimmer, D.Sc.
The Nervous System of the Human Body. By Sir Charles Bell	3rd	1844	,, ,,
Eminent Doctors, their Lives and their Work. 2 vols. By G. T. Bettany		1885	,, ,,
Pathologische Anatomie. 2 vols. Von Prof. Dr. O. Bollinger		1896	,, ,,
A Text-Book of Clinical Diagnosis. By L. N. Boston ..		1904	,, ,,
Pathologisch-Anatomische Sectionstechnik. Von Dr. H. Chiari		1894	,, ,,
Elementary Text-Book of Zoology. 2 vols. By Dr. C. Claus. Translated by Sedgwick and Heathcote		1884	,, ,,
Pathologia e Terapia Chirurgica. Vol. i. By Prof. F. Durante		1895	,, ,,
The Pathology of the Emotions. By Ch. Féré. Translated by Robert Park, M.D.		1899	,, ,,
The Practitioner's Handbook of Treatment. By J. M. Fothergill	2nd	1880	,, ,,
Beiträge zur Klinischen Chirurgie. Vol. lxxviii		1912	,, ,,
Velalfärbung am Zentralnervenlystem. Von Prof. Dr. Edwin E. Goldmann		1913	,, ,,
Die Äussere und Innere Sekretion des Gesunden Organismus im Lichte du "Vitalen Farbung." Von Prof. Dr. Edwin E. Goldmann		1909	,, ,,
Studien zur Biologie du Bösartigen Neubildungen. Von Prof. Dr. Edwin E. Goldmann		1911	,, ,,
A Text-Book of Pathology. 2 vols. By Hektoen and Riesman		1901	,, ,,
Lehrbuch du Pathologitschen Anatomie. 2 vols. Von Dr. F. V. Birch-Hirschfeld		1894-96	,, ,,
Jenaer Glas und Seine Verwendung in Wissenschaft und Technik. Von Dr. H. Hovestadt		1900	,, ,,
Gesundes u. Kraukes Nervensystem. Von Dr. Ch. Jakob		1895	,, ,,
Interne Medicin und Klin. Diagnostik. Von Dr. Ch. Jakob		1897	,, ,,
Säuglingsernährung und Säulingsstoffwechsel. Von Leo Laugstein und L. F. Meyer		1910	,, ,,
Bakteriologische Diagnostik. 2 vols. Von Lehmann und Neumann		1899	,, ,,

LIST OF BOOKS ADDED TO THE LIBRARY—*Continued.*

Title of Work and Author	Edition	Date	How obtained
Allgemeinen Pathologie und Pathologischen Anatomie des Menschen und du Tiere. 10 vols. Von Lubarsch und Ostertag		1897-1901	Presented by Capt. R. H. A. Plimmer, D.Sc.
Gesammette Abhanellungen. Von Dr. E. F. Marxow ..		1893	,, ,,
The Anatomy of the Joints of Man. By H. Morris ..		1879	,, ,,
Human Embryology. By C. S. Minot		1892	,, ,,
The Degeneration of the Neurone. By F. W. Mott ..		1900	,, ,,
Pathology of Syphilis of the Nervous System in the Light of Modern Science. By F. W. Mott		1909	,, ,,
Diseases of the Eye. By E. Nettleship	3rd	1884	,, ,,
Researches on Rheumatism. By Poynton and Paine ..		1913	,, ,,
Sopra la Compressibilita delé Encepalo. By Prof. D. B. Roucali		1898	,, ,,
Trattato dei Neoplesmi Maligni e le Inpezioni Chirurgiche in Generale. Vols. i and ii. By Prof. D. B. Roucali		1911-16	,, ,,
Microscopy. By E. J. Spitta..		1907	,, ,,
Text-Book of General Pathology and Pathological Anatomy. Vol. i. By R. Thoma. Translated by A. Bruce, M.A., M.D.		1896	,, ,,
The Nutrition of the Infant. By R. Vincent	3rd	1910	,, ,,
On Acute Intestinal Toxæmia in Infants. By R. Vincent		1911	,, ,,
The Signs of Life from their Electrical Aspect. By A. D. Waller		1903	,, ,,
Outlines of Osteology. By F. O. Ward		1876	,, ,
Lectures on Specific Fevers and Diseases of the Chest. By S. Wilks		1873-74	,, ,,
Lectures on Diseases of the Nervous System. By S. Wilks		1883	,, ,,
A Biographical History of Guy's Hospital. By Wilks and Bettany		1892	,, ,,
Principles of Microscopy. By Sir A. E. Wright		1906	,, ,,
Technique Bactériologique. Par le Dr. R. Wurtz ..		1892	,, ,,
Atti I Congusso Internazionale dei Patologi		1911	,, ,,
Premier Congrès International de Pathologie Comparée. 3 vols.		1912	,, ,,
Encyklopädie du Mikroskopischen Technik. 2 vols. ..		1903	,, ,,
Jahrbuch für Sexuelle Zwischenstufen. Vols. iii and iv..		1901-02	,, ,,
The Royal Medical and Chirurgical Society of London. Centenary 1805-1905. Written at the request of the President of the Council by Norman Moore, M.D., and Stephen Paget, F.R.C.S.		1905	,, ,,
The Proceedings of the Optical Convention		1912	,, ,,
England and France before Sebastopol. By Charles Bryce, M.D.		1857	Presented by Major-Gen. S. G. Moores, C.B., C.M.G., A.M.S.
The Official Records of the Guards' Brigade in South Africa		1904	,, ,,
The Hunterian Oration on British Military Surgery in the time of Hunter and in the Great War. By Sir Anthony Bowlby, K.C.M.G., K.C.V.O., C.B.		1919	,, ,,
Lectures on the Acute Abdomen. By W. H. Battle, F.R.C.S.		1911	,, ,,
Surgical Experiences in South Africa, 1899-1900. By G. H. Makins, C.B., F.R.C.S.	2nd	1913	,, ,,
United States Naval Medical Bulletin. Report on Medical and Surgical Developments of the War. By William Seaman Bainbridge, Lieut.-Commander, Medical Corps, U.S.A.R. Force		1918	,, ,,

Royal Army Medical College,
January 13, 1920.

OBITUARY.

COLONEL HENRY MAXWELL SLOGGETT.

Col. H. M. Sloggett, who died suddenly at Bournemouth on December 4, 1919, was the son of the late Rev. Charles Sloggett. Educated at Malvern and King's College, London, he joined the Army Medical Service in 1883. Serving in India from 1886 to 1892, he took part in the Meranzai Expedition, 1891, in charge of a Section of a field hospital (medal with clasp).

In June, 1889, he was out in Cholera Camp near Rawal Pindi with a wing of the King's Dragoon Guards. During this very severe epidemic he exhibited the greatest devotion to his duties. Both officers and men held him in the highest esteem for the care and attention he gave them, and his constant efforts to cheer every one up under exceptionally trying circumstances.

Returning to India as a Major in 1897, he served at Kamptee and Quetta, being invalided from the latter station in 1900 owing to ill-health.

In 1901 he served at Shorncliff and Dover, and as Lieutenant-Colonel went to Malta in 1903. He contracted Malta fever in 1905, from which unfortunately he never thoroughly recovered. From 1908 to 1911 he served at Aldershot in charge of the Connaught Hospital.

He returned to Malta in 1912, when His Majesty the King visited his hospital and presented him with his "Coronation Medal" in recognition of his work.

On his promotion to Colonel in 1913 he proceeded to Belfast as Assistant Director of Medical Services, and on the outbreak of war he at once took over charge of the Central Force at Bedford.

In January, 1915, Col. Sloggett was ordered to France, but a Medical Board would not permit his serving overseas. He was Assistant Director of Medical Services, Southern Army, till December 26, 1917, when he was placed on retired pay. Mentioned in the *London Gazette* for his services.

In 1896 he married Monica, daughter of the late N. Coulthurst, Esq., of Gargrave, Yorks.

The late Col. Sloggett was a most conscientious officer, and a man of charming personality. His many friends in all ranks greatly regret his death.

MAJOR-GENERAL JAMES GAUSSEN MACNEECE, C.B.

The recent very sudden death of Major-Gen. J. G. MacNeece on December 13, at Southsea, has removed an Irishman of note. Born in 1856, he was the eldest son of the late Rev. James MacNeece, M.A., Rector of Clonfeacle, County Tyrone, and was the head of a family long connected with that county. Educated at the Royal School, Dungannon, he gained his medical knowledge in Dublin, and obtained the diploma L.R.C.P. & S.I. in 1877. In 1878 he entered the Army Medical Service as a Surgeon, and was promoted Surgeon-Major in 1890, Lieutenant-Colonel in the Royal Army Medical Corps in 1898, Colonel in 1905, and Surgeon-General in 1910. He served in the following expeditions and campaigns: The Afghan War, 1878-80; Bozdar Field Force, 1881; Zhob Valley, 1884; South Africa, 1900-1901, when he was mentioned in dispatches. He was appointed Principal Medical Officer of Malta in 1905, and the Order of St. Maurice and St. Lazarus was conferred upon him by His Majesty the King of Italy, for his services in connexion with the Messina Earthquake in 1908. In 1911 he was made a Companion of the Bath (Military Division). He was Principal Medical Officer of the Lucknow Division, India, from 1910 to 1911. At the commencement of the late war he was appointed Deputy Director of Medical Services of the Central Force, and was subsequently transferred to India and officiated as Director of Medical Services (temporary) from 1915 to 1917, when he was invalided home, but never completely recovered from his illness. He was placed on retired pay in 1917 and was promoted Major-General on the retired list in 1918.

Major-Gen. MacNeece was an excellent all-round medical officer, very kindly and considerate, and justly esteemed by all with whom he served. His favourite recreation was salmon fishing in which he excelled. He married Josephine Alice, second daughter of the late Mr. Nicholas Coulthurst, of Gargrave, Yorkshire.

BIRTHS.

McGRIGOR.—On January 1, 1920, at Streatham Hill, London, the wife of Major D. B. McGrigor, O.B.E., Royal Army Medical Corps, of a son.

SCOTT.—At 12A, The Terrace, Camberley, the wife of Major J. W. L. Scott, D.S.O., Royal Army Medical Corps, a son.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

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	8	0 15 0	0 7 0	12 0	4 3	10 0	2 6
	16	1 6 6	0 12 6				
100	4	0 12 0	0 6 3				
	8	1 0 0	0 10 0	16 0	8 0	14 0	5 0
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Cases for Binding Volumes.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

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Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 56, Cornwall House, Stamford Street, S.E. 1.

Communications have been received from the following: Major-Gen. J. J. Gerrard, Major J. Mackenzie, E. Emrys-Roberts, Esq., M.D.

The following publications have been received:—

British: The Hospital, The Medical Press, The Medical Journal of Australia, The Medical Journal of South Africa, Medical Research Committee, The Practitioner, The Journal of Tropical Medicine and Hygiene, The St. Thomas's Hospital Gazette, Guy's Hospital Gazette, Archives of Radiology and Electrotherapy, The Royal Engineers' Journal, Transactions of the Society of Tropical Medicine and Hygiene, Public Health, St. Bartholomew's Hospital Journal. The Quarterly Journal of Medicine, The Journal of State Medicine, Edinburgh Medical Journal.

Foreign: South Western Medicine, O Exercito Portuguez, Bulletin de la Société de Pathologie Exotique, Surgery, Gynæcology and Obstetrics, Office International d'Hygiène Publique, Revista de la Sanidad Militar, Le Bulletin Médical, United States Public Health Service, The Journal of Infectious Diseases, Bulletin de l'Institut Pasteur, The Military Surgeon, Medicina Militar, Annali di Medicina Navale E Coloniale, Norsk Tidsskrift for Militaermedicin, Abstracts of Bacteriology, Tidskrift i Militär Hälsovard, Bulletin of the Johns Hopkins Hospital.

DECORATIONS CONFERRED BY HIS HIGHNESS THE SULTAN OF EGYPT.

Order of the Nile.

3rd Class.—Lieut.-Col. Cauldwell Hamilton Anderson, M.C., 2nd Light Horse Field Ambulance, Australian Army Medical Corps; Major and Brevet Lieut.-Col. (Acting Lieut.-Col.) Herbert Vale Bagshawe, C.B.E., D.S.O., Royal Army Medical Corps; Capt. (Acting Lieut.-Col.) Hugh Stanley Beadles, Royal Army Medical Corps (Territorial Force); Major (Acting Lieut.-Col.) Alexander Glover Coullie, M.B., F.R.C.S.E., Indian Medical Service; Lieut.-Col. (Temp. Col.) Thomas Henderson Forrest, D.S.O., M.B., Royal Army Medical Corps (Territorial Force); Major (Acting Lieut.-Col.) George Wykeham Heron, D.S.O., O.B.E., Royal Army Medical Corps; Lieut.-Col. Percy Samuel Lelean, C.B., F.R.C.S., Royal Army Medical Corps; Major Alfred William Moore, O.B.E., M.B., Royal Army Medical Corps (Territorial Force).

4th Class.—Major Leonard Avery Avery, D.S.O., Royal Army Medical Corps (Territorial Force); Capt. Arthur Lewin Sheppard, M.B., Indian Medical Service.

DECORATIONS CONFERRED BY THE PRESIDENT OF THE FRENCH REPUBLIC.

Legion d'Honneur.

Officier.—Col. John Charles Baron Statham, C.M.G., C.B.E., late Royal Army Medical Corps.

Chevalier.—Lieut.-Col. R. de Lothbiniere Harwood, Canadian Army Medical Corps.

Croix de Guerre.

Capt. (Acting Major) James Chambers Sproule, Royal Army Medical Corps.
143719 Pte. David Rosie, Royal Army Medical Corps (late Seaforth Highlanders), (Wick).

Medaille des Epidemies (en Bronze).

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Chevalier.—Capt. James Clayton, Royal Army Medical Corps (Territorial Force); Capt. John Duncan Davidson, Royal Army Medical Corps (Territorial Force); Capt. John Golding, D.S.O., Royal Army Medical Corps (Territorial Force).

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF THE HELLENES.

Order of the Redeemer.

Chevalier.—Capt. William Lombard Murphy, Royal Army Medical Corps (Territorial Force).

Greek Medal for Military Merit.

3rd Class.—Temp. Capt. (Acting Major) Philip Maynard Heath, F.R.C.S., Royal Army Medical Corps; Temp. Capt. (Acting Major) Robert Scott, M.B., Royal Army Medical Corps; Capt. Harold Edgar Smith, M.B., Royal Army Medical Corps (Territorial Force); Temp. Major John Heatly Spencer, M.B., Royal Army Medical Corps; Lieut.-Col. Arthur Durham Waring, M.B., Royal Army Medical Corps.

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Order of El Nahda.

3rd Class.—Capt. and Brevet Major (Acting Major) William Edward Marshall, M.C., M.B., Royal Army Medical Corps.

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF ITALY.

Silver Medal for Military Valour.

493309 Pte. Frank Cheeseman, 81st (1st Home Counties) Field Ambulance, Royal Army Medical Corps (Territorial Force) (Maidstone).

Bronze Medal for Military Valour.

510153 Serjt. John Ridge, 84th (1/2nd London) Field Ambulance, Royal Army Medical Corps (Territorial Force) (Purley).

DECORATION CONFERRED BY HIS MAJESTY THE SHAH OF PERSIA.

Order of the Lion and Sun.

3rd Class.—Capt. Charles James Stocker, M.C., M.B., Indian Medical Service.

DECORATIONS CONFERRED BY THE PRESIDENT OF THE PORTUGUESE REPUBLIC.

Military Order of Avis.

Commander.—Temp. Lieut.-Col. George Henry Usmar, O.B.E., South African Medical Corps.

Chevalier.—Capt. Frederic Battinson Smith, M.C., Royal Army Medical Corps (Territorial Force).

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Gold Medal for Zealous Service.

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11812 Qmr.-Serjt. (Temp. Warrant Officer, Class 1) William Charles Banks, Royal Army Medical Corps (attached 21st Stationary Hospital) (Swindon).

27258 Serjt.-Major Josiah Perkins Bent, Royal Army Medical Corps (Glasgow).

41772 Serjt. Percy Rowell, Royal Army Medical Corps (attached 80th Field Ambulance) (Glasgow).

Samaritan Cross.

Lieut. (Temp. Capt.) Frederick Graham Leslie Dawson, Royal Army Medical Corps.

2002 Serjt. George Craddock, Royal Army Medical Corps (Southampton).

493018 Serjt. Herbert Duncan 81st (1st Home Counties) Field Ambulance, Royal Army Medical Corps (Territorial Force) (Chatham).

481371 Pte. Thomas Ewart William Gibson, 1st Eastern General Hospital (attached 41st General Hospital), Royal Army Medical Corps (East Cambridge).

59241 Pte. James McCulloch Hamilton, Royal Army Medical Corps (Girvan).

103157 Cpl. James Hodgkinson, Royal Army Medical Corps (Preston).

66080 Pte. Reginald Kempton, Royal Army Medical Corps (attached 80th Field Ambulance) (Fyfield).

83884 Pte. James Scanlan, Royal Army Medical Corps (Bristol).

493042 Pte. George Sharpe, 81st (1st Home Counties) Field Ambulance, Royal Army Medical Corps (Territorial Force) (Maidstone).

21375 Pte. David John Thomas, Royal Army Medical Corps (Llanberis, North Wales).

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF SIAM.

Order of the White Elephant.

3rd Class.—Capt. and Brevet Major Robert Craig Dun, M.B., F.R.C.S., Royal Army Medical Corps (Territorial Force); Lieut.-Col. R. de Lotbiniere Harwood, Canadian Army Medical Corps; Major (Acting Lieut.-Col.) Richard Chapman Wilson, M.B., Royal Army Medical Corps; Lieut.-Col. and Brevet Col. Sir Edward Scott Worthington, Kt., K.C.V.O., C.B., C.M.G., Royal Army Medical Corps.

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7th Class.—120293 Lance-Cpl. Charles F. Dionne, Canadian Army Medical Corps; 525251 Pte. John George Sommerville, Canadian Army Medical Corps.

War Office,
January 22, 1920.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Man for bravery in the Field with the British Forces in North Russia :—

ARCHANGEL COMMAND.

66829 Pte. P. W. Welch, M.M., Royal Army Medical Corps ((E) High Wycombe). (M.M. gazetted September 28, 1917.)

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ARCHANGEL COMMAND.

Royal Army Medical Corps.

130978 Pte. J. R. Allan (London).
1859 Pte. W. R. Green (Aldershot).
220099 Pte. G. E. Honeywill (Torquay).
75110 Pte. J. F. M. Lines (Lancaster).
200123 Pte. E. Newell (Godalming).
142490 Pte. J. Shuttleworth (Hollingwood).
220000 Pte. H. J. Sprigge (Sydenham).

His Majesty the King has been graciously pleased to approve of the award of the Military Medal to the undermentioned Non-commissioned Officers for bravery in the Field with the British Forces in North Russia :—

MURMANSK COMMAND.

Royal Army Medical Corps.

31476 Staff-Serjt. (Acting Qmr.-Serjt.) W. A. Potter (Birmingham).
495012 Serjt. A. J. Adams (Tunbridge Wells).

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the undermentioned Non-commissioned Officer for valuable services rendered with the British Forces in Siberia :—

Royal Army Medical Corps.

15517 Cpl. (Acting Qmr.-Serjt.) A. Gilchrist (Edinburgh).

St. James's Palace, S.W. 1,
January 23, 1920.

The King has been graciously pleased to approve of the award of the Medal of the Most Excellent Order of the British Empire (Military Division) to the undermentioned, in recognition of valuable services rendered in connexion with military operations in France and Flanders. Dated June 3, 1919.

ROYAL ARMY MEDICAL CORPS.

1570 Pte. (Temp. Qmr.-Serjt) Cyril Kershaw.
1305 Staff-Serjt. (Temp. Serjt.-Major) Herbert Mark Prince.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W. 1,
January 23, 1920.

The King has been graciously pleased to approve of the award of the Medal of the Most Excellent Order of the British Empire (Military Division) to the undermentioned, in recognition of valuable services rendered in connexion with the war. Dated June 3, 1919.

ROYAL ARMY MEDICAL CORPS.

26 Staff-Serjt. (Acting Serjt.-Major) Frederick Bax.
1894 Serjt. (Acting Serjt.-Major) Herbert John Benjafield.
Late Staff-Serjt. C. Sammut.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W. 1,
January 30, 1920.

The King has been graciously pleased to give orders for the following appointment to the Most Excellent Order of the British Empire, in recognition of valuable services rendered in the Field and brought to notice in accordance with the terms of Army Order 193 of 1919. To be dated May 5, 1919 :—

To be an Officer of the Military Division of the said Most Excellent Order :—

Qmr. and Capt. Walter Samuel Rivers, Royal Army Medical Corps (Territorial Force), attached 2/1st S. Mid. Field Ambulance.

AWARDED THE MILITARY CROSS.

Temp. Capt. William Joseph Maloney, Royal Army Medical Corps.

His Majesty the King has been graciously pleased to approve of the award of the Military Medal to the undermentioned Men for bravery in the Field, whose services have been brought to notice in accordance with the terms of Army Order 193 of 1919. To be dated May 5, 1919, unless otherwise stated :—

ROYAL ARMY MEDICAL CORPS.

6659 Pte. D. Davis (Walsall).
6123 Pte. J. Delaney (Mountmellick).
5819 Pte. H. W. Hopper (Dover).
19906 Pte. S. C. Letchford (Okehampton).

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the undermentioned Warrant Officer and Men, in recognition of devotion to duty and valuable services rendered whilst prisoners of war or interned, which services have

been brought to notice in accordance with the terms of Army Order 193 of 1919. To be dated May 5, 1919:—

ROYAL ARMY MEDICAL CORPS.

8288 Serjt.-Major M. Andrews (Edinburgh).
5352 Pte. E. Allenby (New York, U.S.A.).
16224 Pte. G. Constable, M.M. (Colne).
2178 Pte. H. E. Felstead, M.M. (Battersea).
341393 Pte. J. Hughes (St. Helens).
72720 Pte. C. F. W. Sayers (Brighton).

The names of the undermentioned Officers, Warrant Officer, Non-commissioned Officers and Men have been brought to the notice of the Secretary of State for War, in accordance with the terms of Army Order 193 of 1919, for valuable services rendered whilst prisoners of war or interned. Dated May 5, 1919:—

ROYAL ARMY MEDICAL CORPS.

Lieut.-Col. P. H. Collingwood.
Temp. Capt. H. M. Gilbertson, attached 6th Battalion Somerset Light Infantry.
Temp. Capt. A. J. Gilfillan,
Temp. Capt. R. W. Hodgson-Jones, attached Royal Irish Fusiliers.
Temp. Capt. J. L. Jackson, M.B.
Capt. W. H. R. McCarter.
Temp. Capt. A. T. I. Macdonald, M.D.
Capt. S. S. Meighan (Territorial Force).
Capt. L. Murphy, D.S.O.
Major W. R. O'Farrell.
Capt. C. E. Redman.
Major J. Startin.
Capt. A. Sutcliffe, M.B.
Major W. I. Thompson.
Temp. Capt. E. A. Walker.
Capt. W. Warburton.
337038 Serjt. G. Bradshaw, 65th Field Ambulance (Territorial Force).
11236 Serjt. B. A. Emblin.
37516 Pte. (Acting Serjt.) A. H. Fowweather.
46756 Pte. F. J. Gardiner.
52503 Pte. J. Gray.
344037 Serjt. J. Howell (Territorial Force).
1843 Staff-Serjt. (Acting Serjt.-Major) C. A. Mack.
17006 Pte. R. Mair.
459365 Staff-Serjt. J. A. R. Mitchell (Territorial Force).
44/395033 Pte. J. E. Neale (Territorial Force).
11582 Serjt.-Major J. Ryan.
4460 Pte. A. A. Saunders.
461097 Pte. W. J. Wheeler, 26th Field Ambulance (Territorial Force).

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W. 1.
January 30, 1920.

The King has been graciously pleased to give orders for the following appointments to the Most Excellent Order of the British Empire for valuable services rendered in or in connexion with military hospitals, territorial hospitals, war hospitals, auxiliary and civil hospitals, command depots, convalescent camps, or on other duties of a similar nature in the United Kingdom in connexion with the Army during the war:—

To be Officers of the Civil Division of the said Most Excellent Order:—

Lieut.-Col. William George Patrick Alpin, M.D., M.R.C.S., L.R.C.P.
Major Albert Edward Morison, M.B., F.R.C.S.
Major Joseph FitzGerald Blood, M.D., M.Ch.
Major George Henry Darwin, M.D., F.R.C.P.
Lieut.-Col. Mercier Gamble, M.D., Ch.B.,
Capt. Edward Williams Hedley, M.D.

CHANCERY OF THE ORDER OF SAINT MICHAEL AND SAINT GEORGE.

Downing Street,
February 3, 1920.

The King has been graciously pleased to give directions for the following appointment to the Most Distinguished Order of Saint Michael and Saint George, on the recommendation of the General Officer Commanding-in-Chief, Allied Forces, for Services rendered in connexion with Military Operations in Archangel, North Russia. Dated November 11, 1919.

To be additional Member of the Third Class, or Companion of the said Most Distinguished Order:—

Capt. (Acting Lieut.-Col.) Duncan Campbell Lloyd Fitzwilliams, M.D., F.R.C.S., Royal Army Medical Corps (Territorial Force).

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W. 1.
February 3, 1920.

The King has been graciously pleased to give orders for the following appointments to the Most Excellent Order of the British Empire, on the recommendation of the General Officer Commanding-in-Chief, Allied Forces, in recognition of valuable services rendered in connexion with Military Operations in Archangel, North Russia. Dated November 11, 1919.

To be Commanders of the Military Division of the said Most Excellent Order:—

Temp. Capt. (Acting Major) Eric Stewart Marshall, M.C., late Royal Army Medical Corps.

Col. George St. Clair Thom, C.B., C.M.G., M.B., late Royal Army Medical Corps.
To be Officers of the Military Division of the said Most Excellent Order :—
Major (Acting Lieut.-Col.) Alfred William Adamson Irwin, Royal Army Medical Corps.
Major (Acting Lieut.-Col.) John Maurice Bisdee Rahilly, M.B., Royal Army Medical Corps.
Capt. (Acting Lieut.-Col.) Thomas Heyliger Richmond, Royal Army Medical Corps, Territorial Force.

War Office,
February 3, 1920.

The King has been graciously pleased to approve of the undermentioned rewards, on the recommendation of the General Officer Commanding-in-Chief, Allied Forces, for distinguished service in connexion with military operations in Archangel, North Russia. Dated November 11, 1919, unless otherwise stated :—

To be Brevet Major :—
(On Retired List, Reserve of Officers, Special Reserve, New Army or Territorial Force, in the case of Officers belonging to these categories as applicable).
Capt. H. C. Rook, Royal Army Medical Corps (Special Reserve).

AWARDED THE DISTINGUISHED SERVICE ORDER.

Major Archer Irvine-Fortescue, M.B., Royal Army Medical Corps.

AWARDED THE MILITARY CROSS.

Capt. Jeremiah John Magner, M.B., 156th Field Ambulance, Royal Army Medical Corps.

War Office,
February 3, 1920.

His Majesty the King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned Non-Commissioned Officer for Distinguished services rendered in connexion with military operations in Archangel, North Russia. Dated November 11, 1920 :—

AWARDED THE DISTINGUISHED CONDUCT MEDAL.

308011 Serjt. G. A. Hay, Royal Army Medical Corps (Territorial Force), (Aberdeen).

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W. 1,
February 3, 1920.

The King has been graciously pleased to give orders for the following appointments to the Most Excellent Order of the British Empire, on the recommendation of the General Officer Commanding-in-Chief, Allied Forces, in recognition of valuable services rendered in connexion with military operations in Murmansk, North Russia. Dated November 11, 1919 :—

To be Officers of the Military Division of the said Most Excellent Order :—
Capt. (Acting Major) Charles George Gordon Keane, Royal Army Medical Corps.
Temp. Capt. (Acting Major) Alexander Hepburn Macklin, M.C., M.B., Royal Army Medical Corps.
Capt. (Acting Lieut.-Col.) John Forbes William Sandison, M.C., M.B., Royal Army Medical Corps (Special Reserve).
Temp. Capt. (Acting Major) Thomas Victor Somerville, M.C., Royal Army Medical Corps.
To be Members of the Military Division of the said Most Excellent Order :—
Temp. Qmr. and Lieut. James George Annand Forbes, Royal Army Medical Corps.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W. 1,
February 3, 1920.

The King has been graciously pleased to give orders for the following appointments to the Most Excellent Order of the British Empire, on the recommendation of the General Officer Commanding, British Military Mission, in recognition of valuable services rendered in connexion with military operations in South Russia. Dated November 11, 1919 :—

To be Officer of the Military Division of the said Most Excellent Order :—
Capt. Trevor Aveling Butcher, Royal Army Medical Corps (Special Reserve).
To be Member of the Military Division of the said Most Excellent Order :—
Temp. Qmr. and Capt Frederick William Sharpe, D.C.M., Royal Army Medical Corps.

War Office,
February 3, 1920.

The King has been graciously pleased to approve of the undermentioned reward, on the recommendation of the General Officer Commanding the British Military Mission, for distin-

guished service in connexion with military operations in South Russia. Dated November 11, 1919:—

To be Brevet Major:—

Capt. C. S. P. Hamilton, D.S.O., Royal Army Medical Corps.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W. 1,
February 3, 1920.

The King has been graciously pleased to give orders for the following appointments to the Most Excellent Order of the British Empire, on the recommendation of the Government of India, in recognition of valuable services rendered in connexion with military operations in Bushire. Dated June 3, 1919:—

To be a Commander of the Military Division of the said Most Excellent Order:—

Lieut.-Col. (Temp. Col.) Charles Harford Bowle-Evans, C.M.G., M.B., I.M.S.

To be Officers of the Military Division of the said Most Excellent Order:—

Major Thomas Scarborough Budding, Royal Army Medical Corps.

Major (Acting Lieut.-Col.) William Lapsley, M.B., Indian Medical Service.

War Office,
February 3, 1920.

The King has been graciously pleased to approve of the undermentioned reward, on the recommendation of the Government of India, for distinguished service in connexion with Military operations in Persia (Bushire Force), dated June 3, 1919:—

To be Brevet Major:—

Capt. (Acting Lieut.-Col.) H. R. B. Gibson, M.B., Indian Medical Service.

War Office, S.W. 1.
February 3, 1920.

The names of the undermentioned have been brought to the notice of the Secretary of State for War by Gen. H. S. Lord Rawlinson, G.C.B., G.C.V.O., K.C.M.G., A.D.C., General Officer Commanding-in-Chief, Allied Forces, North Russia, for valuable and distinguished services rendered in connexion with the operations in North Russia during the period March 25 to September 26, 1919. Dated November 11, 1919:—

ARCHANGEL.

Commands and Staff.

Col. G. St. C. Thom, C.B., C.M.G., M.B., Royal Army Medical Corps.

Royal Army Medical Corps.

Temp. Lieut. F. C. S. Bradbury, M.B.
Qmr. and Capt. G. A. Collier.
Capt. (Acting Lieut.-Col.) D. C. L. Fitzwilliam, M.D., F.R.C.S., Royal Army Medical Corps (T.F.).
Temp. Capt. (Acting Major) R. T. Grant.
Capt. (Acting Major) E. H. Hughes, M.C., Royal Army Medical Corps (T.F.).
Temp. Capt. (Acting Lieut.-Col.) E. R. Hunt. M.D.
Major A. Irvine-Fortescue, M.B.
Major (Acting Lieut.-Col.) A. W. A. Irwin.
Temp. Capt. (Acting Lieut.-Col.) R. Jamison, M.B., F.R.C.S.
Temp. Capt. (Acting Major) E. S. Marshall, M.C.
Major (Acting Lieut.-Col.) J. M. B. Rahilly, M.B.
Capt. (Acting Lieut.-Col.) T. H. Richmond, M.B., Royal Army Medical Corps (T.F.).
Temp. Capt. R. L. Sinclair, M.B.
L eut. (Temp. Capt.) C. E. Spicer, M.C.
Temp. Capt. (Acting Major) J. D. Watson, M.C., M.B.
Capt. (Acting Lieut.-Col.) J. B. A. Wigmore, M.B.
220015 Lance-Cpl. W. Buchanon, 155th Field Ambulance.
129089 Pte. (Acting Cpl.) F. N. Fielding.
127785 Pte. J. Geogehan.
220153 Serjt. R. Kearns, M.M., 139th Sanitary Section.
15783 Staff Serjt. (Acting Serjt.-Major) E. F. H. Lloyd.
200082 Pte. W. Moore, 156th Field Ambulance.
18257 Serjt. J. Percy, D.C.M., 155th Field Ambulance.
142490 Pte. J. Shuttleworth.
125783 Serjt. M. A. Sillery.

War Office, S.W. 1,
February 3, 1920.

The names of the undermentioned have been brought to the notice of the Secretary of State for War by General H. S. Lord Rawlinson, G.C.B., G.C.V.O., K.C.M.G., A.D.C., General Officer Commanding-in-Chief, Allied Forces, North Russia, for valuable and distinguished services rendered in connexion with the operations in North Russia during the period March 1 to October 12, 1919. Dated November 11, 1919:—

MURMANSK.

Royal Army Medical Corps.

Temp. Capt. (Acting Major) T. E. Coulson.
Capt. (Acting Major) H. R. Friedlander.
Capt. J. Hope.
Capt. (Acting Major) C. G. G. Keane.
Temp. Qmr. and Lieut. H. G. Lenton.
Temp. Capt. (Acting Major) A. H. Macklin, M.C.
Major (Acting Col.) E. L. Moss, C.M.G., M.C.
Capt. (Acting Lieut.-Col.) J. J. D. Roche.
Capt. (Acting Lieut.-Col.) J. F. W. Sandison, M.C. (Special Reserve).
Capt. L. J. Schwartz (Special Reserve).
Temp. Capt. (Acting Major) T. V. Somerville, M.C.
Capt. M. D. Vint (Special Reserve).
129259 Pte. (Acting Cpl.) J. Crewe.
26705 Cpl. (Acting Qmr.-Serjt.) J. Garbett.
76140 Pte. (Acting Serjt.) H. Hacking.
545484 Staff-Serjt. H. H. Morgan.
417061 Serjt. H. Richardson.
28367 Serjt. H. Roberts.
450060 Pte. (Acting Serjt.) F. Tasker.
500008 Qmr.-Serjt. W. Trott.
220014 Serjt. E. E. Woodward.
27811 Cpl. (Acting Serjt.) J. R. Young.

War Office,
February 3, 1920.

The name of the undermentioned has been brought to the notice of the Secretary of State for War by the General Officer Commanding the British Military Mission, for valuable and distinguished services rendered in connexion with the operation in South Russia. Dated November 11, 1919:—

Capt. T. A. Butcher, Royal Army Medical Corps (Special Reserve).

War Office,
February 3, 1920.

The names of the undermentioned have been brought to the notice of the Secretary of State for War for valuable services rendered with the Bushire Force in Persia during the period from April 1, 1918, to March 31, 1919. Dated June 3, 1919:—

Capt. A. L. Badcock, Royal Army Medical Corps (Territorial Force).
Major T. S. Dudding, Royal Army Medical Corps.
Capt. O. M. Finney, Royal Army Medical Corps (Territorial Force).
Capt. W. E. Hodgins, Royal Army Medical Corps (Territorial Force).
Capt. T. Kennedy, Royal Army Medical Corps (Territorial Force).
266461 Pte. V. G. May, 42nd British General Hospital, Royal Army Medical Corps.
119609 Pte. G. R. Moulds, Royal Army Medical Corps.
266166 Pte. J. H. Wolland, 42nd British General Hospital, Royal Army Medical Corps.

COMMUNIQUÉ.

War Office,
February 9, 1920.

The names of the undermentioned are to be added to those brought to the notice of the Secretary of State for War for valuable services rendered in connexion with the war, which were published in the Press Communiqué, dated August 28, 1919.

GREAT BRITAIN.

Eastern Command

106069 Pte. H. Gardner, Royal Army Medical Corps.
25531 Staff-Serjt. L. Gear, Royal Army Medical Corps.

Northern Command.

Temp. Capt. E. B. Barton, Royal Army Medical Corps.
Major (Acting Lieut.-Col.) W. Murray, Royal Field Artillery (Territorial Force), (Temp. Major, Royal Army Medical Corps).
408070 Pte. (Acting Serjt.) W. H. Lawson, Royal Army Medical Corps (Territorial Force).

Southern Command.

Capt. A. S. Barnes, Royal Army Medical Corps (Territorial Force).
Qmr. and Capt. E. C. Bennison, Royal Army Medical Corps (Territorial Force).
Capt. E. C. Bradford, Royal Army Medical Corps (Territorial Force).
Temp. Major Archibald Campbell, Royal Army Medical Corps.
Capt. C. R. Girdlestone, M.B., F.R.C.S., Royal Army Medical Corps (Territorial Force).
Temp. Capt. J. Graham, Royal Army Medical Corps.
Major (Acting Lieut.-Col.) W. Kirkpatrick, Royal Army Medical Corps (Territorial Force).
Temp. Capt. A. W. Macgregor, Royal Army Medical Corps.
Major-Gen. Sir W. W. Pike, K.C.M.G., D.S.O., F.R.C.S.I., Army Medical Service.
Temp. Capt. A. H. Priestley, Royal Army Medical Corps.
Qmr. and Capt. S. Sulley, Royal Army Medical Corps.
Temp. Capt. J. H. K. Sykes, Royal Army Medical Corps.
Lieut.-Col. and Brevet Col. S. J. Thomson, Royal Army Medical Corps.
Temp. Capt. A. H. Ward, Royal Army Medical Corps.
27642 Serjt. (Acting Staff-Serjt.) F. H. Newcombe, Royal Army Medical Corps.

Irish Command.

Temp. Capt. A. E. Wynne, M.D., F.R.C.S.I., Royal Army Medical Corps.

AMENDMENTS.

The undermentioned, whose names have been brought to the notice of the Secretary of State for War for valuable services rendered in connexion with the war, are now correctly described.

Published in the Press Communiqué, dated August 28, 1919.

Under the heading London District:—

97231 Pte. (Acting Staff-Serjt.) A. E. Chandler, Royal Army Medical Corps.

21067 Serjt. A. D. Harris, Royal Army Medical Corps.

23222 Cpl. (Acting Serjt.) A. Jenvey, Royal Army Medical Corps.

23249 Staff-Serjt. C. H. Orchard, Royal Army Medical Corps.

Under the heading Northern Command:—

Lieut.-Col. W. Murray, Royal Field Artillery (Territorial Force) (Temp. Lieut.-Col. Royal Army Medical Corps).

393302 Pte. (Acting Serjt.) A. H. Daley, Royal Army Medical Corps (Territorial Force).

408229 Serjt. (Acting Staff-Serjt.) A. Smith, Royal Army Medical Corps (Territorial Force).

120093 Pte. (Acting Serjt.) J. B. Wadham, 322nd (Welsh) Field Ambulance, Royal Army Medical Corps (Territorial Force).

The heading 33rd Army Corps is deleted, and for it is substituted 23rd Army Corps.

Under the heading Bermuda:—

5260 Serjt. A. J. Bew, Royal Army Medical Corps.

War Office,
February 11, 1920.

His Majesty the King has been graciously pleased to approve of the award of the Military Medal to the undermentioned Men for bravery in the field:—

FRANCE AND FLANDERS.

(Except where otherwise stated.)

Royal Army Medical Corps.

512523 Pte. F. G. Baker, 2/3rd Field Ambulance (Lower Edmonton).

341619 Pte. H. Heyes, 1/3rd W. Lancs. Field Ambulance (St. Helens).

339272 Pte. A. L. Watkins, 63rd Field Ambulance (Liverpool).

AMENDMENTS.

The following are the correct descriptions of the undermentioned Warrant Officers, Non-commissioned Officers and Men whose names have recently appeared in the *London Gazette* for the award of the Military Medal and Meritorious Service Medal.

Military Medal.

London Gazette, dated July 19, 1917. 50929 Pte. J. Bridson, Royal Army Medical Corps.

London Gazette, dated March 13, 1919. 61112 Pte. C. Devenhill, Royal Army Medical Corps.

London Gazette, dated July 23, 1919. 14457 Pte. (Acting Serjt.) J. McCann, Royal Army Medical Corps.

Meritorious Service Medal.

London Gazette, dated June 17, 1918. 417054 Staff-Serjt. C. F. Beck 1/1st (North Midland) Field Ambulance, Royal Army Medical Corps.

London Gazette, dated January 30, 1919. 390001 Temp. Serjt.-Major R. W. Edwards, Royal Army Medical Corps.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

St. James's Palace, S.W. 1.
February 12, 1920.

The King has been graciously pleased to give orders for the following appointments to the Most Excellent Order of the British Empire, on the recommendation of the General Officer Commanding-in-Chief Mesopotamia Expeditionary Force, in recognition of valuable services rendered in connexion with military operations in Southern and Central Kurdistan. Dated November 15, 1919.

To be Officers of the Military Division of the said Most Excellent Order:—

Capt. Hugh Michael Collins, Indian Medical Service.

Major James Forgan Grant, Royal Army Medical Corps, attached 39th Combined Field Ambulance.

Major (Acting Lieut.-Col.) Alfred Spitteler, Indian Medical Service.

CENTRAL KURDISTAN.

The names of the undermentioned have been brought to the notice of the Secretary of State for War for valuable services rendered during the military operations in Central Kurdistan. Dated November 15, 1919.

Royal Army Medical Corps.

Major J. F. Grant.
Capt. (Acting Major) J. M. Weddell.
464042 Lance-Cpl. F. H. M. Bott.

SOUTHERN KURDISTAN.

The name of the undermentioned has been brought to the notice of the Secretary of State for War for valuable services rendered during the military operations in Southern Kurdistan. Dated November 15, 1919.

Royal Army Medical Corps.

Lieut. (Acting Capt.) L. G. Blackmore.

War Office,
February 17, 1920.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign :—

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question :—

DECORATIONS CONFERRED BY HIS EXCELLENCY THE PRESIDENT OF THE REPUBLIC OF CHINA.

Order of Wen-Hu.

4th Class.—Temp. Major (Acting Lieut.-Col.) William Harold Graham Aspland, M.D., F.R.C.S., Royal Army Medical Corps; Temp. Major Stafford Mouritz Cox, M.D., Royal Army Medical Corps; Temp. Major Thomas Norton Frood, Royal Army Medical Corps; Temp. Major (Acting Lieut.-Col.) George Douglas Gray, O.B.E., M.D., Royal Army Medical Corps.

5th Class.—Temp. Capt. Percy Campbell Leslie, M.D., Royal Army Medical Corps; Temp. Capt. Henry Delahunt Mattews, M.B., Royal Army Medical Corps; Temp. Capt. Ernest John Peill, M.B., F.R.C.S., Royal Army Medical Corps; Temp. Capt. John William Pell, Royal Army Medical Corps; Temp. Capt. William Robert Reeds, M.B., Royal Army Medical Corps.

DECORATIONS CONFERRED BY THE GOVERNMENT OF THE REPUBLIC OF PANAMA.

Medal of "La Solidaridad."

3rd Class.—Capt. (Acting Major) William Kealty Campbell, D.S.O., M.C., M.B., Royal Army Medical Corps; Capt. and Brevet Major (Acting Major) William Leckie Webster, M.B., Royal Army Medical Corps; Capt. (Acting Major) John Murray Weddell, Royal Army Medical Corps.

CENTRAL CHANCERY OF THE ORDER OF KNIGHTHOOD.

St. James's Palace, S.W. 1.,
February 24, 1920.

His Majesty the King has been graciously pleased to give orders for the following promotions in, and appointments to, the Most Excellent Order of the British Empire, in recognition of valuable services rendered in connexion with the War. Dated June 3, 1919:—

To be Commander of the Military Division of the said Most Excellent Order:—

Temp. Lieut.-Col. Richard John Morris, Royal Army Medical Corps.

ARMY MEDICAL SERVICE.

Major-Gen. William T. Swan, C.B., retires on retired pay, dated December 26, 1919.

The undermentioned to be Acting Colonels:—

Dated November 22, 1918.—Major (Acting Lieut.-Col.) George W. Heron, D.S.O., O.B.E.

Dated June 7 to October 1, 1919.—Lieut.-Col. William P. Gwynn, C.M.G.

Major-Gen. James B. Wilson, C.B., C.M.G., M.D., is placed on half-pay, dated February 7, 1920.

Col. Thomas H. M. Clarke, C.M.G., C.B.E., D.S.O., retires on retired pay, dated February 1, 1920.

Col. Daniel D. Shanahan, C.M.G., D.S.O., is placed on half-pay, dated January 6, 1920.

ROYAL ARMY MEDICAL CORPS.

Major Joseph E. H. Gatt, M.D., retires on retired pay, dated January 22, 1920.

Temp. Capt. Robert B. Blair, M.B., F.R.C.S., relinquishes the acting rank of Major, dated April 6, 1919 (substituted for the notification in the *Gazette.* of June 27, 1919).

The notification in the *Gazette* of July 1, 1919, regarding Captain and Brevet Major L. Dunbar is cancelled.

Major William I. Thompson, D.S.O., M.B., relinquishes the acting rank of Lieutenant-Colonel, dated June 10, 1919.

Major William H. Forsyth, D.S.O., M.B., relinquishes the acting rank of Lieutenant-Colonel, dated October 18, 1919 (substituted for the notification in the *Gazette* of December 2, 1919).

Major and Brevet Lieut.-Col. Dudley S. Skelton, D.S.O., is seconded for service under the Colonial Office, dated January 9, 1920.

Capt. Joseph P. Quinn, M.C., M.B., resigns his commission, dated January 24, 1920.

The name of Capt. James R. Hill, M.B., is as now described, and not as in the *Gazette* of October 14, 1919.

Lieut.-Col. John P. J. Murphy, M.B., is placed on the half-pay list on account of ill-health, dated January 28, 1920.

Major Alfred B. Hinde, O.B.E., retired pay, is granted the rank of Lieutenant-Colonel on ceasing to be re-employed, dated September 8, 1919.

Capt. Robert M. Dickson, O.B.E., M.D., relinquishes the acting rank of Lieutenant-Colonel, dated November 6, 1919.

Capt. Edward G. H. Cowen, M.B., retires, receiving a gratuity, dated January 28, 1920.

Capt. Robert O'Kelly relinquishes the acting rank of Lieutenant-Colonel, dated May 14, 1919.

Lieut. (Temp. Capt.) Harold J. Bensted, M.C., to be Captain, dated December 5, 1919.

Brevet Lieut.-Col. Charles W. Holden, C.M.G., D.S.O., dated December 24, 1919.

Temp. Capt. Patrick J. Lane, M.C., M.B., relinquishes the acting rank of Major, dated March 22, 1919.

Capt. John E. Rusby, M.C., resigns his commission, dated June 20, 1919 (substituted for the notification in the *Gazette* of June 18, 1919).

Capt. Philip C. Field is restored to the establishment, dated October 29, 1919.

Major William Byam, O.B.E., to be Temporary Lieutenant-Colonel whilst specially employed, dated January 20, 1920.

Major and Brevet Lieut.-Col. Barry A. Craig, relinquishes the acting rank of Lieutenant-Colonel, dated May 6, 1919.

Major Marcus G. Dill, M.D., retires on retired pay, dated February 5, 1920.

Temp. Capt. (Acting Major) James La F. Lauder, D.S.O., M.C., to be Lieutenant, and to be Temporary Captain, dated August 8, 1914, but not to reckon for pay or allowances prior to January 1, 1917, with precedence next below W. B. Allen, and to retain his acting rank (substituted for the notification in the *Gazette* of September 5, 1918).

Lieut. (Temp. Capt.) (Acting Major) James La F. Lauder, D.S.O., M.C., to be Captain, February 8, 1918, and to retain his acting rank (substituted for the notification in the *Gazette* of March 3, 1919).

The notification in the *Gazette* of January 23, 1920, regarding Capt. George H. Stacke, M.B., is cancelled.

Lieut.-Col. Gilbert S. Crawford, C.M.G., M.D., retires on retired pay, dated February 10, 1920.

Major and Brevet Lieut.-Col. Eugene Ryan, C.M.G., D.S.O., to be Acting Lieutenant-Colonel from April 15 to October 28, 1919.

Lieut.-Col. Henry M. Nicholls, M.B., retires on retired pay, dated February 13, 1920.

Major Robert G. H. Tate, M.D., to be temporary Lieutenant-Colonel whilst specially employed, dated January 23, 1920.

Major Walter Tibbits, M.B., is placed on retired pay, dated February 1, 1920.

Capt. Hugh A. Sandiford, M.C., M.B., to be Acting Major from July 12, to August 18, 1919.

Capt. Geoffrey D. Harding, M.B., to be Acting Major, dated October 28, 1918 (substituted for the notification in the *Gazette* of October 27, 1919).

Major and Brevet Lieut.-Col. Geoffrey W. G. Hughes, D.S.O., relinquishes the acting rank of Lieutenant-Colonel, dated October 18, 1919.

Lieut.-Col. James G. McNaught retires on retired pay, dated February 20, 1920.

Capt. Philip C. Field is restored to the establishment, dated November 23, 1919 (substituted for the notification in the *Gazette* of February 3, 1920).

Major and Brevet Lieut.-Col. Wallace Benson, D.S.O., M.B., relinquishes the temporary rank of Lieutenant-Colonel, dated March 11, 1919.

Temp. Major Edward B. C. White, relinquishes his commission on ceasing to be employed at the Welsh Metropolitan War Hospital, dated December 19, 1919, and retains the rank of Major.

Lieut.-Col. Charles S. Smith, M.B., is placed on the half-pay list on account of ill-health, dated February 23, 1920.

Major Ibar A. O. MacCarthy retires on retired pay, dated February 23, 1920.

Capt. John W. C. Stubbs, D.S.O., M.C., M.B., is seconded for service with the Egyptian Army, dated January 3, 1920.

The undermentioned relinquish the acting rank of Lieutenant-Colonel :—

Dated March 19, 1919.—Capt. George H. Stacke, M.B.

Dated March 31, 1919.—Major George R. Painton.

Dated November 7, 1919.—Major and Brevet Lieut.-Col. Wallace Benson, D.S.O., M.B.

Dated November 20, 1919.—Capt. James R. Hill, M.B.

Dated September 22, 1919.—Capt. Augustus J. Hickey, M.C.; Capt. Leopold T. Poole, D.S.O., M.C., M.B.; Major Benjamin A. Odlum, O.B.E.

Dated October 22, 1919.—Major and Brevet Lieut.-Col. Dudley S. Skelton, D.S.O.

Dated October 24, 1919.—Major Richard B. Hole, M.B.

Dated November 22, 1919.—Major and Brevet Lieut-Col. Maurice G. Winder, D.S.O.

Dated November 28, 1919.—Capt. William D. Anderton, M.C., M.B.

Dated November 30, 1919.—Major Arthur W. Gater.
Dated December 18, 1919.—Major Osborne Ievers, D.S.O., M.B.
Dated December 19, 1919.—Major Thomas B. Unwin, D.S.O., M.B.

The undermentioned to be Acting Lieutenant-Colonels :—
Dated August 20, 1919.—Major and Brevet Lieut.-Col. Barry A. Craig.
Dated September 5, 1919.—Capt. Clifford H. K. Smith, M.C., M.B.
Dated September 22, 1919.—Major Thomas H. Scott, D.S.O., M.C., M.B.
Dated December 20, 1919.—Major Gerald H. Stevenson, D.S.O., M.B.

The undermentioned Captains relinquish the acting rank of Major :—
Dated February 28, 1919.—Sarsfield J. A. H. Walshe, D.S.O., M.B.
Dated March 1, 1919.—Galvin E. A. Argo, M.C., M.B.
Dated May 29, 1919.—Thomas F. Kennedy, O.B.E., M.B.
Dated July 11, 1919.—George A. Bridge, M.C., M.B.
Dated July 15, 1919.—Gilbert G. Collet, M.B.
Dated September 16, 1919.—Sidney J. L. Lindeman, M.C.
Dated September 22, 1919.—Francis R. H. Mollan, M.C.
Dated October 8, 1919.—Frederick G. Flood, M.C., M.B.
Dated October 9, 1919.—Hawtrey W. Browne, M.C., M.B.
Dated November 19, 1919.—John P. Litt, M.D.
Dated November 21, 1919.—George G. B. Holroyde, M.C.
Dated December 28, 1919.—Edward G. S. Cane, D.S.O.
Dated December 30, 1919.—William J. Tobin.
Dated January 4, 1920.—Alan G. Wells, D.S.O.
Dated January 12, 1920.—Edward A. Strachan, M.B.

The undermentioned to be acting Major :—
Dated October 4, 1919.—Capt. Manfred Morris, M.B.

The undermentioned Captains to be Majors :—
Dated February 1, 1920.—Francis R. Coppinger, O.B.E., M.B.
Dated February 4, 1920.—Alfred C. Hammond-Searle, M.C., M.B. ; John E. Ellcome ; Gerald J. Keane, D.S.O., M.D. ; Brevet Major Harold H. Blake, O.B.E., M.B. ; Robert M. Dickson, O.B.E., M.D. ; (Acting Major) Frank Worthington, D.S.O., O.B.E., M.B. ; Alexander L. Stevenson, M.B. ; Bernard Varvill, M.C. ; (Acting Major) Joseph W. Houston, D.S.O., M.B. ; Brevet Major Arthur Shepherd, M.B. ; Wilfred J. Dunn, O.B.E., M.B. ; Frank B. Dalgliesh ; (Acting Major) Spencer G. Walker, M.B. ; Charles E. L. Harding, M.B. ; (Acting Major) Arthur L. Foster ; Claude M. Rigby ; (Acting Major) Alan G. Wells, D.S.O. ; Brevet Major Alexander E. G. Fraser ; Walter H. S. Burney ; Thomas E. Eves, D.S.O., M.B. ; Leo Murphy, D.S.O. ; Arthur H. T. Davis ; John S. McCombe, D.S.O., M.B. ; William J. Tobin ; (Acting Major) Campbell McQueen, M.C. ; Robert O'Kelly.

The undermentioned Lieutenants (Temporary Captains) to be Captains :—
Dated January 1, 1920.—Charles O. J. Young, M.C., M.B. ; Ronald N. Phease, M.B.
Dated January 12, 1920.—Charles B. C. Anderson, M.B.
Dated January 13, 1920.—Philip E. D. Pank.
Dated January 15, 1920.—Geoffry Moulson.
Dated January 24, 1920.—Walter J. F. Craig, M.B.

The undermentioned Majors relinquish the acting rank of Lieutenant-Colonel :—
Dated July 9, 1919.—George A. K. H. Reed.
Dated December 11, 1919.—Harold W. Farebrother.
Dated December 29, 1919.—Richard C. Wilson, M.B.

The undermentioned relinquish the acting rank of Major :—
Dated March 31, 1919.—Capt. Walter H. S. Burney.
Dated April 19, 1919.—Capt. Alexander L. Stevenson, M.B.
Dated January 5, 1920.—Capt. Walter E. Adam, M.C., M.D.
Dated January 10, 1920.—Capt. James C. Sproule.

The undermentioned Captains to be Acting Majors :—
Dated January 4 to June 13, 1918.—William T. Graham, O.B.E.
Dated January 4 to August 13, 1918.—Francis A. Robinson, M.C., M.B. ; Edward P. A. Smith, O.B.E., M.C., M.B.
Dated February 4 to August 13, 1918.—Robert W. Vint, M.B.
Dated June 12, 1919.—Thomas Young, M.B.

The undermentioned Captains resign their commissions :—
Dated February 10, 1920.—Joseph W. O'Brien, M.C., M.B. ; William Moodie, M.D.

The undermentioned Captains are seconded for service under the Colonial Office :—
Dated December 12, 1919.—Charles D. M. Buckley, M.C., M.B. ; William C. Hartgill, M.C. ; Thomas J. L. Thompson, M.C., M.B.

The undermentioned relinquish the acting rank of Major :—
Capt. and Brevet Major William E. Marshall, M.C., M.B., dated November 20, 1919.

ARMY MEDICAL OFFICERS' WIDOWS AND ORPHANS FUND.

SUMMARY OF THE PROCEEDINGS OF A MEETING OF THE COMMITTEE WHICH WAS HELD AT THE ROYAL ARMY MEDICAL COLLEGE ON JANUARY 26, 1920.

Present.

Deputy Surg.-Gen. W. G. Don, President in the Chair.
Major-Gen. W. S. M. Price, Vice-President.
Major-Gen. Sir G. D. Bourke, K.C.M.G., C.B., Vice-President.
Major-Gen. Sir W. B. Leishman, K.C.M.G., C.B., F.R.S., K.H.P.
Major-Gen. S. Guise Moores, C.B., C.M.G.
Col. Sir R. H. Firth, K.B.E., C.B.
Lieut.-Col. J. F. Martin, C.M.G., C.B.E.
Brevet Col. W. R. P. Goodwin, D.S.O.
Lieut.-Col. A. C. H. Gray, O.B.E.
Major W. F. M. Loughnan, M.C.

(1) The Minutes of the previous meeting were read and confirmed.

(2) The death was reported on October 27, 1919, of Colonel A. H. Anthoniz, a married member, and his widow was placed on the list of annuitants.

The death was reported on December 30, 1919, of an annuitant, Anna Maria, widow of the late Deputy Inspector General J. S. Piers Moore, aged 91.

(3) The following were admitted as married members:—

Major F. C. Cowtan	subscription	£13	8	8
Major W. Egan, D.S.O.	,,	15	1	6
Captain F. R. Fletcher	,,	13	4	10
Captain A. S. Heale, M.C.	,,	15	18	1
Major J. C. L. Hingston	,,	15	1	6
Captain E. C. Lang, D.S.O.	,,	12	3	4
Captain W. K. Morrison, D.S.O.	,,	11	18	2
Major D. de C. O'Grady, D.S.O.	,,	19	11	9

Capt. J. R. Hill was transferred from the unmarried to the married list, subscription, £16 13s. 10d.

(4) The Secretary reported that, as authorized at the previous meeting, £2,500 five per cent war stock 1929/47 had been purchased out of cash surplus on the advice of the consulting actuary of the Honorary Treasurer, the cost being £2,260, 1s. 9d. The purchase of a further £500 of the same stock was authorized.

(5) In view of the depreciation in value of the securities held by the Society a report on this subject from the Consulting Actuary was submitted to the Committee, who after careful consideration of it resolved that no change of investment was advisable. (The Report will be found below.)

(6) A certificate from the Actuary was submitted that the securities held by the Society were trustee securities on December 31, 1919.

(7) Payment of the Actuary's fee for the past year was sanctioned, it being resolved that, in view of the conditions existing at present it be increased from £10 10s. to £15 15s.

(8) Payment of a printer's bill of £3 8s. was sanctioned,

(9) Payment of the Secretary's orders for the quarter ended December 31, 1919, was authorized, also of office allowance, and refund of petty cash expended by him.

3, *Homefield Road,* J. T. CLAPHAM, *Captain.,*
Wimbledon, S.W. *Secretary.*

REPORT OF THE CONSULTING ACTUARY ON THE SECURITIES HELD BY THE SOCIETY AT DECEMBER 31, 1919.

61, Carey Street,
Lincoln's Inn, W.C. 2.,
January 15, 1920.

DEAR CAPTAIN CLAPHAM,—I have looked at your figures as to the depreciation of the securities as at December 31 last and I agree with the amount you show, £7,771.

I should like to make a few remarks as to this depreciation which, in the circumstances of the Society, is not so important as it might seem at the first glance.

The investments of the fund may be divided into two groups:—

(1) Those redeemable absolutely during the next thirty years (i.e., in 1950 or earlier) at par or (in the case of the National War Bonds) at 105.

(2) Those either irredeemable or redeemable only at the option of the borrowers and the 4 per cent Funding Loan which I put in this group as it may not be redeemed until 1990.

Group (1) consists of:—

		Value December 31, 1919.
£126,500 5 °/。 War Stock 1929/1927	at 91½	£115,747 10 0
£8,000 5 °/。 National War Bonds 1927 and 1928 ..	at 98	7,840 0 0
£5,500 Canada 3½ °/。 1950	at 68	3,740 0 0
£2,000 Newfoundland 3½ °/。 1950	at 68	1,360 0 0
Total value at December 31, 1919 (about 85 °/。 of total investments)		£128,687 10 0

The depreciation in this group is £4,495.

Having regard to the large surplus (£50,000) over the actuarial liability of the Fund shown at the last quinquennial valuation and the large annual income from interest in excess of the amount required on the basis of the Actuarial Valuation (such excess being well over £4,000 a year) I think it is improbable that the Society will require to realize these investments before they mature for redemption.

Whilst, therefore, for the purposes of the Balance Sheet and of the Actuarial Valuation the securities must be valued strictly at market price, I think the Committee may fairly assume that ultimately these securities will yield a substantial surplus over present values. Even if some of the securities have to be realized later on, but before maturity, they will, as the dates of maturity get nearer, tend to approach their redemption values.

I do not think any question arises as to the intrinsic value of these securities.

With regard to Group (2) the following are the securities:—

		Value December 31, 1919.
£4,000 4 °/。 Funding Loan	at 76	£3,040 0 0
£5,000 London County Council 3½ °/。	at 63½	3,175 0 0
£5,000 Metropolitan Water Board 3 °/。 "B" Stock ..	at 55½	2,775 0 0
£5,000 Great Western Railway 4 °/。 Debenture Stock ..	at 75	3,750 0 0
£5,000 London and North Western Railway 3 °/。 Debenture Stock	at 56	2,800 0 0
£1,500 Caledonian Railway 4 °/。 Debenture Stock ..	at 68	1,020 0 0
£7,900 Midland Railway 2½ °/。 Debenture Stock ..	at 45	3,574 15 0
£2,000 East India Railway 3½ °/。 Debenture Stock ..	at 61	1,281 0 0
Total value at December 31, 1919 (about 15 °/。 of total investments)		£21,415 15 0

The depreciation in this group is £3,270 and is of more importance, but it should be remembered that the income is unaffected (in the case of the Society even by Income Tax) and that when the investments have been written down to present prices they show a higher yield per cent on the new values.

These investments represent (except in the case of the Funding Loan) security for a fixed rate of interest payable in perpetuity, the capital value rising or falling in accordance with the condition of the money market, and also, of course, with the investor's estimate of the intrinsic value.

With regard to the intrinsic value, the railway investments consist entirely of debenture stocks, and I cannot think that the circumstances will arise to imperil the payment of the interest on these first charges of the railway companies. I feel, however, that this is not a subject for an actuarial forecast.

With regard to future prices, as effected by the condition of the money market, it is worthy of note that first class permanent securities give a lower yield at present prices than first class redeemable securities, for example:—

Consols (redeemable only at par) yield under 5 per cent. Great Western and London and North Western Railways Debenture Stock yield nearly £5 10s.; whilst 5 per cent War Loan 1929/47 yields £5 13s. (including premium on redemption in 1947), and the shorter term Government securities give a higher yield.

The reason is that many investors prefer to be assured of 5 or 5½ per cent in perpetuity rather than a higher yield for a shorter period with the possibility that when the period ends they may not be able to secure so good a rate.

Having regard to the nature of the investments under Group (2) above and the small proportion of the total funds which these investments represent, I am inclined to think that they may be retained, but if the Committee feel at all doubtful as to the securities, I think there can be no harm in exchanging them for redeemable securities of the British Government, say the five per cent 1929/1947 War Loan or five per cent National War Bonds 1928 (redeemable at 105) with a higher yield until redemption (the premium on redemption being included) and with an unknown yield after redemption.

Believe me, yours faithfully,
(Signed) Robt. R. Tilt.

Captain J. T. Clapham, R.A.M.C.
Secretary, Army Medical Officers'
Widows and Orphans Fund.

Note.—In connexion with the above Report the following details may be of interest to members:—

On December 31, 1918, a depreciation of £833 18s. 7d. was shown, but at the same date in 1917 it amounted to £3,094 8s. 7d.

The values of securities shown in the printed Balance Sheet, from which the present depreciation has taken place, are those to which securities then held were written down at the quinquennial valuation at December 31, 1915. In the case of securities purchased since that date the cost price is shown.

The amount of depreciation written off at December 31st, 1915, was £9,464. This sum would have been very much larger but for the fact that at that date £100,855 of the Secretary's funds were on deposit with the National Debt Commissioners, and therefore escaped depreciation. In February, 1917, the total deposited with the Commissioners had risen to £104,386. This was withdrawn and invested in five per cent War Stock 1929/47, at 95, yielding about 5¼ per cent instead of the 3½ per cent received from the Commissioners.

January 20, 1920. J. T. C.

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

SUMMARY OF THE PROCEEDINGS OF A MEETING OF THE COMMITTEE WHICH WAS HELD AT THE ROYAL ARMY MEDICAL COLLEGE ON FEBRUARY 2, 1920.

Present:

Major G. A. D. Harvey, C.M.G., representing Curragh Mess, in the Chair.
Major H. Dunbar Walker, O.B.E., representing Western Command.
Major G. G. Tabutean, D.S.O., representing Woolwich Mess.
Brevet Lieut.-Col. W. Benson. D.S.O., representing Rawal Pindi Mess.
Major T. S. Blackwell, representing Aldershot Mess.
Major E. C. Phelan, D.S.O., M.C., representing Southern Command.
Major D. B. McGrigor, O.B.E., representing Northern Command.
Major B. A. Odlum, O.B.E., representing Eastern Command.
Major C. M. Rigby, representing London Mess.
Brevet Major P. S. Tomlinson, D.S.O., representing London District.
Brevet Major R. Gale, D S.O. representing Cosham Mess.

(1) On the proposal of Lieut.-Col. Benson, seconded by Major Walker, Major Harvey took the Chair, in the absence of Lieut.-Col. P. Davidson.

(2) The Minutes of the previous Meeting were read and confirmed.

(3) The question was considered of payment by the Fund of the railway and freight expenses from Cairo of the collection of heads, seventy-four in number, which Lieut.-Col. Sir John Rogers wishes to present to the London Mess. Letters were laid before the Committee from Major-Gen. Sir F. R. Newland in which he says that it is a wonderful collection, in excellent order and well worth any expense which might be incurred by the Central Mess Fund. Every endeavour has been made to arrange for shipping the collection by transport, but without success. There are forty large cases (which have been obtained free of cost by Gen. Newland) and he estimates that approximately £200 will be needed to cover freight and railway charges.

It was resolved that Gen. Newland be asked whether it would be possible to ship home the collection of Sir John Rogers' heads piecemeal, either on hospital ships, or as baggage accompanying officers of the Corps returning to England.

(4) The *Tidworth* Mess having applied to the Committee for recognition as a permanent mess, and a report for help having been received from the mess at Stobs Castle, it was resolved that the War Office be approached as to whether these were likely to be permanent messes. (Later, the President Mess Committee Stobs Castle wrote to say that a grant or loan would not now be necessary).

(5) On the proposal of Major Tabutean, seconded by Major Tomlinson, it was resolved that the mess silver placed at the disposal of the Committee by the members of the late Royal Army Medical Corps Mess at Roberts' Heights, Pretoria, be apportioned, by agreement of the mess secretaries concerned, between the Royal Army Medical Corps Depôt Mess at Tweseldown and the messes at Cosham and Tidworth. The share of the last-named to be a loan, pending a decision under Minute 4.

(6) The members of the late Royal Army Medical Corps Mess at Quetta, having placed its credit balance at the disposal of the Committee just before the outbreak of the war, it was reported that this amounted to Rs. 536, and was on fixed deposit with the Alliance Bank of Simla till February 20, when it would be transferred to the account of the Central Mess Fund.

(7) It was reported that the grant of £20 which had been made, under very special circumstances, to the mess at Addington Park had been returned, as the financial position of the mess had much improved.

(8) Refund of £5 16s., expended by the Hon. Secretary in office on stationery, typing, postage, etc., was sanctioned.

(9) Resolved on the proposal of Lieut.-Col. Benson, seconded by Major Dunbar Walker, that the following recommendations be made to the Annual General Meeting:—

(*a*) That the Fund purchase the outstanding six per cent Debentures of the Rawal Pindi Mess which amount to Rs. 10,850. [The Mess was originally bought for Rs. 11,000, and is now worth considerably more. It is Corps property and the up-keep, repairs, payment of interest and repayment of principle has to be met by officers stationed in Rawal Pindi.]

(b) In the event of the General Meeting being unfavourable to this proposal, the alternative suggested is that a yearly grant be made to the mess to help to pay interest and repay capital.

(10) Proposed by Major McGrigor, seconded by Major Odlum :—

That all messes be asked to have a standard joining contribution of two days' pay for subscribers to the Central Mess Fund, and if not, less than two days' pay for non-subscribers. Carried.

J. T. Clapham,
Captain,
Hon. Secretary.

3, *Homefield Road,*
*Wimbledon, S.W.*18.

ROYAL ARMY MEDICAL CORPS MEMORIAL.[1]

MEETING IN DUBLIN.

THE LORD CHANCELLOR'S APPEAL.

At a meeting held yesterday at the Royal College of Surgeons, St. Stephen's Green, Dublin, several speeches were made in support of the proposed war memorial in connexion with the Royal Army Medical Corps. The President of the Royal College of Surgeons (Mr. J. B. Story) presided. There was a representative attendance. Letters of apology for non-attendance were received, amongst others, from the Earl of Donoughmore, Sir Robert Jackson and Sir Thomas Myles.

The Chairman said that they had had communications from London so far back as March last, suggesting that a memorial should be erected to the officers, non-commissioned officers and men of the Royal Army Medical Corps. A committee was then appointed to carry out the terms of a resolution that a permanent memorial or monument be erected to the officers, non-commissioned officers and men of the Corps who fell in the war, with, if possible, replicas in Dublin and Edinburgh. He asked Colonel William Taylor to tell the meeting what progress was being made in furtherance of the memorial project.

Colonel William Taylor said that last March the Director-General asked him, as representative from Ireland, to join the Central Committee in London. He did so, and on his suggestion it was decided at a meeting of the Committee that one big memorial should be erected in London, with replicas in Edinburgh and Dublin, to the memory of the officers, non-commissioned officers and men of the Royal Army Medical Corps who fell in the war. At a meeting of the Committee in November last it was found that £10,000 stood to the credit of the fund, and arrangements were made to give all an opportunity of subscribing to it.

The Lord Chancellor.

The Lord Chancellor, who was cordially received, stated that there were many reasons for his confidence that the resolution which he had to propose—"That the memorial was worthy of their support"—would receive their cordial sympathy and acquiescence. The Royal Army Medical Corps had a great and long record of honourable service, marked by increasing efficiency and marvellous progress in medical and surgical science. He saw many present who were for many years distinguished members of that branch of the Service, and the names of others must occur to them—Keogh, Gubbins, Fawcett, Burtchaell and Hickson—all men who had not only reflected lustre on their Corps, but secured honour and distinction for themselves. Perhaps to a degree beyond any of the branches of their military departments, the Royal Army Medical Corps found itself prepared and equipped at the outbreak of war, and it was able to cope with the demands made upon it for the needs of our fighting forces at home and abroad, and, with the aid of the magnificent organization of the Red Cross, it was for some time quite adequate to the demands made upon it. As the days and months of the terrible war progressed a call had to be made for volunteers from among the civilian members of the profession, and they ought never to forget the ready response with which that call was met, nor should they forget the way in which the women of their race responded to the appeal, and gave untiring energy and devotion to the nursing of wounded and maimed soldiers, and also the many at home who supplied comforts and medical and surgical appliances that were indispensable to successful treatment. They in Ireland had reason to reflect with pride and satisfaction on the part that their own country had played in this respect, because the call for volunteers was responded to not only by the men of light and leading in the profession, but by local practitioners who could ill afford to do so, and, with very few exceptions, all the available civilian practitioners joined up to do whatever work they were fit for, having regard to their age and experiences and went willingly to do whatever duty was allotted to them.

The Royal Army Medical Corps in the Field.

The war had been responsible for many acts of remarkable heroism, but he doubted if any were performed in circumstances more calculated to rack the nerves and quail the hearts of the bravest of men than the acts of the members and officers of the Royal Army Medical

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[1] *The Irish Times*, Wednesday, February 11, 1920.

Corps in the field. These duties were carried out in circumstances of intense horror and tragedy, and the way in which these brave and devoted men stuck to their posts and performed their duties while stormed at by shot and shell had earned for them undying fame and a record which they at home would be ungrateful if they forgot. He thought that they might fairly claim that the Corps as a whole had responded to all that was expected of them, and did their duty in a manner worthy of the great traditions of the Service to which they belonged, and the officers and men who had fallen had died in defence of King and country and in obedience to the call of duty. They should, therefore, see that, though they could not adequately honour the memory of those gallant men in the far and scattered lands in which these young heroes slept, their memory would be perpetuated in the country of their home in a manner worthy of them and of the cause for which they had fought and fell. In these days they were hampered by many appeals of this kind, and few could afford to contribute without some self-denial, yet he ventured to say that the most generous and liberal contributor would have to confess that his generosity was but light in comparison to the sacrifice of those who so freely gave their lives, and by their deaths had secured the blessings of peace, freedom and liberty. In the circumstances he felt that through a mere sense of gratitude alone the appeal would meet with generous sympathy and support.

President Royal College of Physicians.

The President of the Royal College of Physicians seconded the resolution. He said that it was a striking tribute to the work and heroic sacrifice of the Royal Army Medical Corps that they had present at that meeting representatives of the two great professions, Divinity and Law—the Primate of All Ireland and the Lord Chancellor of Ireland. As a representative of the medical profession, he took that opportunity of thanking them for the great interest they showed in the project of erecting a fitting memorial to the memory of the officers and men of the Royal Army Medical Corps by honouring them with their presence at that meeting. When the full history of the war came to be written he was quite sure that the record of the Royal Army Medical Corps would bear favourable comparison with the work of any other branch of the Service. In that connexion, with the tremendous organization accomplished by the regular members of the Service, he would like to mention the names of two Fellows of the Royal College of Surgeons—Sir Alfred Keogh and Sir Charles Burtchaell—whose efforts contributed considerably and successfully to the treatment of the wounded and sick during the war. The death roll of the Corps was a very long one. He had no means of knowing what it amounted to, but it included the names of some of the bravest and best-known members of the Medical Schools of Ireland. Not less than ninety-five members of the School of Physic, Trinity College, Dublin, laid down their lives, and thirty-five deaths occurred amongst those who had taken out their courses in connexion with the Royal University. University College, Dublin, lost sixteen members; University College, Cork, fourteen, and University College, Galway, five. The total roll of licentiates and Fellows of his College was seventy-eight, and as far as he had gone into the figures he had accounted for two hundred, which did not include the Queen's University, Belfast, or graduates throughout Ireland who had attained their qualifications from English and Scottish bodies. Amongst those who had given up their lives in the service of the Royal Army Medical Corps were Sir Victor Horsley, who was always willing to take up any cause and defend it when he felt it deserved support; Lieut.-Col. Charles Dalton, who made his reputation not only in the late war, but in the South African War, Captain Earnest Deane, who was awarded the Military Cross in 1915; Lieut.-Col. Henry Moore who was twice mentioned for bravery on the field in 1916, and awarded the Military Cross and D.S.O. in 1918; and Captain Taylor, who was also awarded the Military Cross in 1918. Those facts and figures paid a much more eloquent tribute than any he could pay to the memory of those who had fallen in the war and in the service of the Royal Army Medical Corps. He would like to refer, too, to the record of the students of Trinity College, for whom special examinations had to be held to give them an opportuity of playing their part in the war.

The resolution was unanimously adopted.

The Primate.

The Primate, who was cordially received, said that he first asked himself what right he had to accept the kind invitation to come there and help in forwarding the erection of the memorial. The answer was—and he would like to give it to hundreds and hundreds of civilians outside the Royal College of Surgeons and the Royal Army Medical Corps—that there was no memorial ever proposed to be erected that had a greater claim on ordinary civilians than this, because, whatever connexion they might have as individuals with particular regiment, college, or University in regard to the erection of a memorial, every one of them was more or less intimately related with the work of the Royal Army Medical Corps in the field and at home. There was hardly one of them who had not a relation serving in the war who did not owe a deep debt of gratitude to the Corps, and he believed that he might say that the whole of humanity owed an enormous debt to the strides made in medical and surgical science in the Corps during the recent war. He had been furnished with statistics giving the exact number of casualties of the Royal Army Medical

Corps during the war. The number of officers killed in action was 259. Did anyone realize what these men took upon themselves when they went into the battle line, not to fight, but to succour the wounded? They laid down their lives for their fellow-men, and ungrudgingly paid the penalty. The number of officers who died of wounds was 141, the number who died from other causes was 168, making a total of 568. He would not enter into the details regarding the casualties amongst other ranks of the Corps, but 5,445 members made the supreme sacrifice. Was it, therefore, not right and fitting that there should be some outward and visible sign indicating what these gallant men had done? Was it not right, lest they forgot, that they should be reminded of what had happened and what might happen again? He was not one of those sentimentalists who said that the late war was a war against all wars, and that they had reached a time when war was ended. He believed that if they took proper precautions they might prevent another war breaking over the world. In erecting a memorial in Dublin to those brave members of the Royal Army Medical Corps who sacrificed their lives in the cause of humanity, civilians should play their part with glad and thankful hearts. He begged to propose: "That we approve of the Committee that has already been formed, with power to add to its numbers."

Major-Gen. Gerrard, senior officer of the Army Medical Service in Ireland, in seconding the resolution, expressed the regret of the Director-General at his inability to be present at the meeting, as the erection of a memorial to the officers and men of the Royal Army Medical Corps was a project he had very much at heart.

The resolution was adopted.

At the close of the meeting subscriptions to the Memorial Fund were invited.

The Committee.

The following Committee has been elected:—

The Earl of Donoughmore; Earl Iveagh; Major-Gen. Gerrard; Sir James H. Campbell, the Most Rev. J. B. Crozier, D.D.; the Lord Chief Justice of Ireland, Sir D. Plunket Barton; Sir A. Dempsey; Col. Sir Arthur Chance; Sir Robert H. Woods; Sir A. Ball; Bart.; Col. Sir W. Crook-Lawless; Col. T. Sinclair, C.B.; Major-Gen. J. J. Russell, C.B.; Maurice F. Headlam, the Provost, Trinity College; Col. O'Carroll; President University College, Dublin; President University College, Cork; President University College, Galway; President Irish Medical Association; J. B. Story, President Royal College of Surgeons; Col. William Taylor, C.B.; James Craig, President Royal College of Physicians; Sir L. H. Ormsby; Sir Auckland C. Geddes, K.C.B.; Col. T. M. Clarke, C.M.G.; Major-Gen. Sawyer, C.B.; Col. Sir Thomas Myles, C.B.; Lieut.-Col. W. R. Dawson; Lieut.-Col. F. Conway Dwyer; Major C. de Burgh Daly; Hon. A. E. Guinness; Lieut.-Col. E. J. R. Evatt; Lieut.-Col. Seton Pringle; Col. J. C. Connor, C.M.G.; Lady Constance Butler, Col. A. Fullerton, C.B.; Mr. Justice Pim; Right Hon. M. F. Cox; Andrew Jameson; Sir John Lumsden, K.B.E.; Sir John P. Lynch, J.P.; C. Wisdom Hely, J.P.; C. A. Pim; John B. Dunlop; M. J. O'Connor; William Ross; Professor S. Young; Dr. Ninian Falkiner; Dr. W. A. Winter; Dr. G. E. Palmer; G. S. Phillpots; Mrs. Lee; Mrs. L. Alcock; J. R. Bristow; S. Geoghegan; Dr. W. B. Somerville-Large; C. J. McCormack; Dr. S. D. Reeves; Dr. D. J. O'Connor; Dr. Myles Keogh; L. Morrough Ryan; Dr. W. G. Smith; Rev. C. Fausset; Major S. G. Walker; Major R. S. Gregg; Dr. E. Sheridan; Dr. G. Sheppard; Capt. A. W. W. Baker; Capt. J. B. Burgess; Capt. J. A. Matson; Dr. T. N. Smith; Dr. J. Marshall Day; Major A. Whewell; Capt. G. Hewson; Dr. R. C. B. Maunsell; Dr. R. J. Rowlette; Major W. F. Law; Dr. R. A. Stoney; J. M. Colles, LL.D.: Professor Auchinlech; C. W. R. Brady; Dr. E. G. Fenton; A. S. M. Imrie; Alfred Werner; J. T. Hudson; J. J. McCarthy; Neuman Thomson: C. Gamble; M. P. Mahony; Capt. R. M. Minchin; G. C. May; A. A. McCall, J.P.; Dr. G. O'Keeffe Wilson; John Holliday; Dr. Arthur Chance; Capt. T. O. Graham; Capt. C. W. C. Robinson; Dr. J. V. Cope; Dr, McDowel Cosgrave; Major D. S. Browne; R. W. Strahan; J. P. Garland; William Kennedy; Dr. M. Briscoe; Dermod O'Brien; Capt. J. A. O'Keeffe; D. E. M. Maxwell; Capt. J. H. Grove White; George Prescott; Dr. G. Jameson Johnston; O. P. Beater; J. Maguire, J.P.; J. Mallagh, C.E.; Dr. G. Scriven; P. J. Fitzmaurice; Dr. G. J. Tierney; J. M. Burns; Dr. L. Cassidy; James Henry; T. G. McGrath; Dr. R. B. McCausland; George Green; Rev. F. E. Bland; Dr. G. E Moore; Sir G. Stokes, K.C.S.I.; Dr. R. J. Taaffe: Dr. R. Hatch; Miss A. L. Massey; Dr. T. Hennessy; E. C. Erck; H. R. Jameson; T. W. N. Greene; Rev. Dr. Denham Osborne; C. W. Wilson; W. Lindsay; Dr. H. W. Oulton; Sir John Moore, M.D.; T. E. Potterton; Rev. John Pim; Professor William Caldwell; Dr. A. Blayney; Eastwood Biggar; H. Dudgeon; Sir Charles A. Cameron, C.B.; Dr. E. Coey Biggar; Dr. William Stoker; Capt. R. P. McDonnell; Dr. T. P. C. Kirkpatrick; Professor E. H. Tweedy; Capt. J. B. Taylor; Capt. P. J. Ryan; Dr. H. C. Mooney; Dr. G. Peacocke; Major G. Buchanan; Capt. G. Bateman; Major Adye-Curran; Capt. H. O'Neill; Capt. R. Wright; Capt. H. Alcock: Capt. J. W. Graham; Lieut.-Col. R. J. W. Mawhinny, C.B.; Major J. Rahilly; Sir Joseph Redmond: Capt. J. R. Hill; Lieut.-Col. T. McDermott, Major W. I. Thompson; John A. Lanphier. Chairman: The President, Royal College of Surgeons in Ireland. Hon. Treasurers: Sir John Lynch, Major-Gen. Gerrard. Hon. Secretary: Alfred Miller.

LIST OF SUBSCRIPTIONS.

£100. J. B. Dunlop.
£25. Col. T. M. M. Clarke, C.M.G.
£21. Right Hon. Sir Auckland C. Geddes, K.C.B., M.P.
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£1 1s. each. G. O'Keeffe Wilson, F.R.C.S.I.; John Holliday; Arthur Chance, F.R.C.S.I.; T. O. Graham, F.R.C.S.I.; Capt. C. W. C. Robinson; J. V. Cope, F.R.C.S.I.; McDowel Cosgrave, M.D.; Major D. S. Browne; Dr. J. P. Garland; W. Kennedy, F.T.C.D.; Dr. M. Briscoe; Dermod O'Brien; Capt. J. A. O'Keeffe; Capt. J. H. Grove White; R. W. Strahan; Sir Robert Woods, F.R.C.S.I.; Miss E. M. Maxwell, F.R.C.S.I.; George Prescott; G. Jamieson Johnston, F.R.C.S.I.; O. P. Beater; John A. Lamphier; J. Maguire, J.P.; Capt. J. W. Graham; J. Mallagh, C.E.; Capt. H. Alcock; P. J. Fitzmaurice, J. P.; Capt. R. A. Wright; G. Scriven, M.D.; Capt. H. O. H. O'Neill; G. J. Tierney, F.R.C.S.I.; Major Adye Curran; J. M. Burns; Capt. G. Bateman; L. Cassidy, F.R.C.S.I.; Major G. Buchanan; James Henry.
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12s. Detachment Royal Army Medical Corps, Holywood War Hospital.
10s. 6d. Rev. Dr. Denham Osborne.
10s. C. W. Wilson.
5s. each. Serjt.-Major Parker; Cpl. Keily.
2s. 6d. W. O. N. Lindsay.

DEATHS.

ELLIOTT.—On January 28, 1920, at 36, C.C.S., Cologne, of influenzal pneumonia, Captain William Herron Elliott, M.B.E., Royal Army Medical Corps, youngest son of (the late) Dr. J. M. Elliott and Mrs. Elliott of Rathfriland, Co. Down, Ireland.

HAYES.—At her residence, 3, Marlborough Buildings, Bath, on January 24, after a short illness, Minnie Albinia Lennard Hayes (neé Lennard Barrett), the beloved wife of Lieut.-Col. E. C. Hayes, C.B.E., Royal Army Medical Corps (retired).

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

Major arrived Egypt December, 1919, for tour, would exchange to go India now or next trooping season. Consideration required. Apply A.C.E., c/o. "Journal of the R.A.M.C.," 8, Serle Street, London, W.C. 2.

FOR SALE.—Khaki tunic, breast 38½ ins., length 32 ins., unworn, can be seen at HAWKES & Co., Savile Row. A Sowter hunting saddle, in excellent condition. A military saddle, unused. No reasonable offers refused. Apply to L. FIRWOOD EDGE, Firwood Drive, Camberley.

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	8	1 0 0	0 10 0				
	16	1 17 0	0 15 6				
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Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 56, Cornwall House, Stamford Street, S.E. 1.

Communications have been received from the following: Lieut.-Col. E. P. Cathcart; Majors N. V. Lothian, J. E. M. Boyd; Capts. M. Greenwood, T. O. Thompson.

The following publications have been received:—

British: The Medical Review, The Journal of the Royal Army Service Corps, The Medical Press, The Hospital, The Royal Engineers' Journal, The Indian Journal of Medical Research, The Middlesex Hospital Journal, Studies in Mental Inefficiency, The British Journal of Surgery. The Practitioner, Medical Research Committee, The Medical Journal of Australia, The British Journal of Tuberculosis, The Journal of Tropical Medicine and Hygiene, Transactions and Eighth Annual Report of the London Dermatological Society, Tropical Veterinary Bulletin, Guy's Hospital Gazette, Bulletin of Entomological Research, Public Health, The Royal Army Service Corps Quarterly, Proceedings of the Royal Society of Medicine, Edinburgh Medical Journal, Guy's Medical Gazette, Indian Medical Gazette, St. Bartholomew's Hospital Journal, The Lister Institute of Preventive Medicine—Collected Papers, Tropical Diseases Bulletin.

Foreign: Le Caducée, The Journal of Infectious Diseases, Colonies et Marne, Le Bulletin Médical, The Military Surgeon, Bulletin de l'Institut Pasteur, Office International d'Hygiène Publique, L'Ospedale Maggiore, Surgery, Gynæcology and Obstetrics, Archives Médicales Belges, Annali di Medicina Navale e Coloniale, Giornale de Medicina Militare, Report of the Surgeon-General United States Army, Bulletin of the Johns Hopkins Hospital.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," Cornwall House, Stamford Street, S.E. 1, and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

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JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

APRIL, 1920.

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
February 26, 1920.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign :—

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF SERBIA.

Order of St. Sava.

5th Class.—Capt. Charles Gunn Skinner, Royal Army Medical Corps (Territorial Force).

Gold Medal for Zealous Service.

79540 Serjt. Lawrence Cecil Brooks, Royal Army Medical Corps (Lytham).

12052 Staff-Serjt. (Temp. Serjt.-Major) Frederick Cuthbert Halkett, Royal Army Medical Corps (Brixton Hill, S.W.).

39376 Serjt.-Major Arthur Joseph Magee, Royal Army Medical Corps (Craghead, co. Durham).

19913 Staff-Serjt. Thomas Samuel Roberts, Royal Army Medical Corps (Admiston, near Salisbury).

Silver Medal for Zealous Service.

70418 Pte. William Charles Bates, Royal Army Medical Corps (Manchester).

106777 Pte. John Thomas Davies, Royal Army Medical Corps (Colwyn Bay).

28749 Pte. Joseph Finch, Royal Army Medical Corps (Altham, Lancs.).

512126 Cpl. (Acting Serjt.) Stanley Gearing, Royal Army Medical Corps (Territorial Force) (Richmond, Surrey).

339451 Pte. William Greatrex, Royal Army Medical Corps (Territorial Force) (Liverpool).

493007 Serjt. Arthur Henry Holtum, Royal Army Medical Corps (Territorial Force) (Maidstone).

69219 Pte. Edward Jones, Royal Army Medical Corps (Llanrug).

27573 Pte. George Reeves, Royal Army Medical Corps (Edmonton).

400102 Pte. Allan Henry Senior, Royal Army Medical Corps (Territorial Force) (Wakefield).

55851 Pte. Fred Standish, Royal Army Medical Corps (" E ") (Derby).

War Office,
March 4, 1920.

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the undermentioned Non-commissioned Officer and Man in recognition of valuable services rendered with the British Military Mission in South Russia :—

ROYAL ARMY MEDICAL CORPS.

7355 Serjt. E. F. Carter (Bletchley).

344095 Pte. (Acting Serjt.) S. J. Hodgson (Liverpool).

ARMY MEDICAL SERVICE.

Major-Gen. Sir William W. Pike, K.C.M.G., D.S.O., F.R.C.S.I., is placed on retired pay, dated March 10, 1920.

Col. Edgar H. Condon, M.B., retires on retired pay, dated March 9, 1920.

Col. Norman Faichnie, M.B., retires on retired pay, dated November 21, 1919. (Substituted for the notification in the *Gazette* of December 8, 1919.)

ROYAL ARMY MEDICAL CORPS.

Lieut.-Col. Leonard Addams-Williams retires on retired pay, dated February 28, 1920.

Major and Brevet Lieut.-Col. Ronald A. Bryden, D.S.O., relinquishes the temporary rank of Lieutenant-Colonel on ceasing to command a medical unit, dated May 20, 1919. (Substituted for the notification in the *Gazette* of November 25, 1919.)

Major Valentine G. Johnson is placed temporarily on the half-pay list on account of ill-health, dated March 2, 1920.

Major Harry T. Wilson, D.S.O., relinquishes the temporary rank of Lieutenant-Colonel, dated September 27, 1919.

Capt. Edward G. S. Cane, D.S.O., M.B., to be temporary Major whilst specially employed, dated January 12, 1920.

Major Joseph E. H. Gatt, M.D., retires on retired pay, dated January 28, 1920. (Substituted for the notification in the *Gazette* of January 21, 1920.)

Captain Gerald J. Keane, D.S.O., M.D., retires, receiving a gratuity, dated April 30, 1919, and the notification in the *Gazette* of February 4, 1920, regarding this Officer is cancelled.

Capt. Stuart Robertson, M.C., M.B., resigns his commission, dated March 10, 1920.

The undermentioned relinquish the acting rank of Lieutenant-Colonel :—

Dated February 19, 1919.—Major and Brevet Lieut.-Col. Arthur W. Gibson.

Dated October 24, 1919.—Major Harry C. Sidgwick, O.B.E., M.B.

Dated November 21, 1919.—Major James H. Campbell, D.S.O., M.B.

The undermentioned Lieutenants (Temporary Captains) to be Captains :—

Dated February 5, 1920.—William D. Whamond, M.B.

Dated February 9, 1920.—Thomas L. Henderson, M.B.

Dated February 10, 1920.—Alistair G. Stevenson, M.B.

Dated February 15, 1920.—Richard H. C. Pryn.

Dated February 22, 1920.—Benjamin J. Daunt.

Dated February 25, 1920.—Arthur J. Bado.

Dated February 28, 1920.—Hugh M. Alexander.

The undermentioned relinquish the acting rank of Major :—

Dated September 22, 1919.—Capt. Herbert G. Winter, M.C.; Capt. and Brevet Major Thomas A. Weston, M.B.

ARMY MEDICAL OFFICERS' WIDOWS AND ORPHANS FUND.

NOTICE.

This Fund provides annuities of £50 a year during widowhood, to the widows of officers who have held permanent commissions in the Royal Army Medical Corps. In the event of the death of the widow this annunity is continued to the children of such marriage until the youngest attains the age of 21 years. It also continues for their benefit, up to the same age, if the widow re-marries. Furthermore, should the wife of the subscriber predecease him, it will be optional for him to continue the subscription he has been paying as a married member, in order to provide an annuity similar to the above for the children of the marriage, until the youngest shall have attained the age of 21 years.

Provision is also made whereby a part of the surplus at any quinquennial valuation may be applied for the benefit of members, or their widows, or orphan children. Thus, by the appropriations of surplus at the valuations of December 31, 1910 and 1915, the prospective widows of first-class married members on the books at those dates will receive, during this current quinquennium, £200 and £100 respectively at the death of their husbands, their annuities being also increased to the statutory limit of £52.

The next valuation will be made at the end of the year 1920.

Unmarried members pay an annual subscription of £2, and on passing to the married class are allowed the equivalent of all past subscriptions in the unmarried class by way of reduction of their annual subscription in the married class. Should they pass to the married list in time of war, they are not liable for any extra charge which may then be in force for new members.

ARMY MEDICAL OFFICERS' WIDOWS AND ORPHANS FUND.

ACCOUNTS FOR THE YEAR 1919.

(In the form prescribed for the Annual Return of a Registered Friendly Society.)

(A) BENEFIT FUND.

DR.

INCOME.	£	s.	d.
Members' Subscriptions..	2,148	14	10
Interest on Investments of Benefit Fund (including amounts recoverable in respect of Income Tax) ..	7,870	10	9
Total Income	£10,019	5	7
Amount of Benefit Fund at the beginning of the year, as per last Balance Sheet	148,823	1	9
	£158,842	7	4

CR.

EXPENDITURE.	£	s.	d.
Widows' Annuities	3,464	16	10
Bonuses to Widows	400	0	0
Refund to Members of proportion of extra War Charges paid in 1918	48	8	9
Interest on £5,719 1s. 9d. (balance of Management Fund at the end of the year 1918) at 3 per cent, transferred to Management Fund	171	11	5
Total Expenditure	£4,084	17	0
Amount of Benefit Fund at the end of the year, as per Balance Sheet (C)	154,757	10	4
	£158,842	7	4

(B) MANAGEMENT FUND.

DR.

INCOME.	£	s.	d.
Interest for one year on £5,719 1s. 9d. at 3 per cent, transferred from Benefit Fund	171	11	5
Amount of Management Fund at the beginning of the year, as per last Balance Sheet	5,719	1	9
	£5,890	13	2

CR.

EXPENDITURE.	£	s.	d.
Secretary's Salary	225	0	0
Actuary's Fee	15	15	0
Auditors' Fee	15	15	0
Office Allowance	60	0	0
Printing, Postages, and Stationery	26	13	2
Reprint of Rules	23	1	3
Total Expenditure	£366	4	5
Amount of Management Fund at the end of the year, as per Balance Sheet (C)	5,524	8	9
	£5,890	13	2

(C) BALANCE SHEET AT DECEMBER 31, 1919.

Dr. LIABILITIES.

Liabilities	£	s.	d.
Benefit Fund, as per Account (A)	154,757	10	4
Management Fund, as per Account (B)	5,524	8	9
Sundry Liabilities—			
Secretary's Salary (from October 1 to December 31, 1919)	62	10	0
Actuary's Fee	15	15	0
Office Allowance	15	0	0
Annuities outstanding	208	0	0
Bonus outstanding..	200	0	0
	£160,783	4	1

To the Members of the Army Medical Officers' Widows and Orphans Fund.

We have examined the above Balance Sheet with the Books and Vouchers of the Society and certify that it is in accordance therewith. The Securities and Cash Balances have been verified by us.

DELOITTE, PLENDER, GRIFFITHS AND CO., } *Auditors*, *Chartered Accountants.*

5, *London Wall Buildings*, *E.C.* 2.

March 27, 1920.

ASSETS. **Cr.**

Investments	Rate per cent of Interest yielded £ s. d.	£	s.	d.
(1) In the Public Funds—				
£126,500 0 0 War Stock, Five per Cent, 1929-1947 ..	5 5 6	119,767	7	10
4,000 0 0 Funding Loan, Four per Cent, 1960-1990	5 0 0	3,200	0	0
3,000 0 0 National War Bonds, Five per Cent, 1927	5 0 0	3,000	0	0
5,000 0 0 National War Bonds, Five per Cent, 1928	5 0 0	5,000	0	0
5,500 0 0 Dominion of Canada Three and a Half per Cent Stock, 1930-1950 (lent to H.M. Treasury at an additional Half per Cent)	5 11 1	3,958	5	8
2,000 0 0 Newfoundland Three and a Half per Cent Stock, 1950 ..	4 16 1	1,456	17	6
(2) Upon the Security of Borough and County Rates, or other Corporate Funds—				
5,000 0 0 London County Council Three and a Half per Cent Stock	4 9 10	3,893	15	0
5,000 0 0 Metropolitan Water Board "B" Three per Cent Stock ..	4 12 1	3,259	7	6
(3) Other Securities—				
5,000 0 0 Great Western Railway Four per Cent Debenture Stock..	4 15 2	4,200	0	0
5,000 0 0 London and North Western Railway Three per Cent Debenture Stock ..	4 13 4	3,215	12	6
1,500 0 0 Caledonian Railway Four per Cent Debenture Stock ..	4 13 4	1,286	5	0
7,900 0 0 Midland Railway Two and a Half per Cent. Debenture Stock..	4 15 8	4,130	4	4
2,100 0 0 East Indian Railway Three and a Half per Cent Debenture Stock	4 17 7	1,506	15	0
NOTE—A Valuation of the above Securities at middle published prices on December 31, 1919, shows a depreciation of £7,771 5s. 4d.				
Interest accrued on Investments		1,169	19	11
Income Tax recoverable		123	2	3
Subscription due..		12	10	11
Cash at Bankers		1,603	0	8
		£160,783	4	1

Examples of the annual subscription for married members which may now be paid in equal half-yearly instalments, are :—

Husband's age	Wife's age	Annual subscription
25	20	£13 8 5
30	27	£14 6 1
36	33	£16 17 2
46	40	£22 12 6
50	45	£24 9 5

Once a member has been admitted, this subscription covers all war and climate risks ; but the Committee has the power to decline applications for membership in war time, or to accept them at an extra charge.

At present no extra charge is being made to applicants serving in any part of the world.

At the end of the year 1919 the funds of the Society, after allowing for the present depreciation of Securities, were of a value of £152,500. The income of the Society in that year was £10,019, and its expenditure £4,279.

The members then numbered 171, and the annuitants 68.

The Secretary will be glad to give further information as to details.

3, *Homefield Road,* J. T. Clapham, *Captain*
Wimbledon, S.W. 19. *Secretary.*
April, 1920.

ROYAL ARMY MEDICAL CORPS FUND (REGULAR ARMY) AND ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY (REGULAR ARMY).

The Annual General Meeting of the Royal Army Medical Corps Fund will be held in the Library of the Royal Army Medical College, Grosvenor Road, S.W., at 2.30 p.m., on Monday, June 14, 1920. The Director-General will preside. It is hoped that all subscribers who can spare the time will be present, and will freely express their views on any point connected with the Fund.

The Annual General Meeting of the Royal Army Medical Corps Benevolent Society will take place immediately afterwards.

Any officers desiring information regarding these Funds are requested to communicate with the Secretary beforehand, so that there may be no delay in dealing with any questions asked.

76, *Claverton Street,* E. M. Wilson, *Lieut.-Colonel,*
S.W. 1. *Secretary.*
Tele. Victoria 2722.

ROYAL ARMY MEDICAL CORPS DINNER, 1920.

The Annual Dinner of the Officers of the Royal Army Medical Corps will take place on Monday, June 14, 1920, in the "Wharncliffe Rooms," Great Central Hotel, Marylebone, N.W.1, at 8 o'clock. President : The Director-General, Army Medical Service.

The price of dinner tickets to subscribers will be 7s. 6d. The price to non-subscribers will be £2 12s. 6d.

It is particularly requested that early application for tickets be made, both by subscribers and non-subscribers, in order that the number attending may be approximately known as soon as possible. Non-subscribers, when applying for tickets, should forward the sum of £2 12s. 6d. by cheque or P.O.O., made payable to the Honorary Secretary. The price of the dinner ticket will be collected from subscribers at the Restaurant on the night of the Dinner.

The following Officers will be regarded as subscribers :—

(1) All existing subscribers to the old Royal Army Medical Corps Dinner Fund, provided they have paid their subscriptions to that Fund for the current year.

(2) All subscribers to the Royal Army Medical Corps Fund, provided their subscriptions are credited to the Fund before the date of the Dinner. Officers who have specially excluded the Annual Dinner in the allocation of their subscription will, of course, be excepted. It has been decided that, with the exception of Mr. Vesey Holt, no guests will be invited.

Selected musicians from the Royal Army Medical Corps Band will perform during Dinner.

Besides one long table, there will be small separate tables to allow of eight Officers sitting at

each, and these will be reserved for parties of eight Officers who wish to dine together, if they will arrange to notify the names to the Honorary Secretary before Thursday, June 10.

A plan of the tables will be on view at the Restaurant on the day of the Dinner. in order that Officers who have not made up parties may select the places at which they wish to sit. A list of Officers who have notified their intention of dining will also be on view,

N.B.—The Monday in Ascot week has been fixed as the day on which the Dinner will be held each year.

Dress.—Evening dress.

Miniature medals will be worn.

Cornwall House,
Stamford Street. S.E. 1.

A. R. WRIGHT, *Captain, R.A.M.C.*,
Hon. Secretary, Royal Army Medical Corps Annual Dinner Committee.

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

THE Annual General Meeting of Subscribers to the Royal Army Medical Corps Central Mess Fund will be held in the Library of the Royal Army Medical College on Monday, June 14, 1920, following immediately that of the Royal Army Medical Corps Officers' Benevolent Society. Officers desiring information about this Fund are asked to communicate with the Hon. Secretary beforehand, so that there may be no delay in dealing with any questions which may be asked. Notice of any definite proposal which it may be desired to bring forward should be sent to the Hon. Secretary in order that it may appear on the agenda paper.

3, *Homefield Road,*
Wimbledon, S.W.
Tele. Wimbledon 750.

J. T. CLAPHAM, *Captain,*
Hon. Secretary.

N.B.—The Annual Corps Dinner will take place the same evening. A separate notice will be issued.

ROYAL ARMY MEDICAL CORPS MESS, LONDON.

AT a Mess Committee Meeting held on February 21, it was decided that in future Guest Nights in this Mess will be held on the second and fourth Fridays of each month (dinner at 7.30 p.m.), and that the Ladies Afternoon "At Home" will be held on the first and third Wednesdays (tea at 4.30 p.m.).

BIRTH.

RIDDICK.—At Sialkot, Punjab, India, on March 29, the wife of Lieut.-Col. G. B. Riddick, of a son.

DEATH.

FOSTER.—On February 22, at Whalley, Lancashire, Major J. R. Foster, Royal Army Medical Corps, aged 38.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

OFFERS.—Uniform Col. A.M.S., Full Dress, Frock Coat, Patrol, Mess Kit, Height 5ft. 10-11in., Chest 37-38in., Cocked Hat, Khaki Helmet 6⅞, Champion & Wilton Side Saddle, Man's Hunting Saddle, Harness, Spurs, Bridles, Overalls, Pantaloons, &c., &c. Col. WESTCOTT, 59, Cadogan Square, S.W. 1.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

Number of Reprints	Number of Pages	Cost of Reprints	Cost of EXCERPTS*	Extra for Covers for Reprints			
				As Journal, Printed on Front	As Journal, Plain, Unprinted	Cheaper Paper, Printed on Front	Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
	4	0 5 6	0 2 6				
12	8	0 10 0	0 5 0	8 6	2 3	7 0	1 6
	16	0 16 6	0 8 6				
	4	0 6 9	0 3 0				
25	8	0 12 0	0 5 9	9 9	3 0	8 9	2 0
	16	1 1 0	0 10 6				
	4	0 9 0	0 4 0				
50	8	0 15 0	0 7 0	12 0	4 3	10 0	2 6
	16	1 6 6	0 12 6				
	4	0 12 0	0 6 3				
100	8	1 0 0	0 10 0	16 0	8 0	14 0	5 0
	16	1 17 0	0 15 6				
	4	0 19 0	0 9 0				
200	8	1 10 0	0 14 0	1 2 0	15 0	18 0	10 0
	16	2 12 0	0 18 0				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

Cases for Binding Volumes.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 3s. 9d. net; binding, 3s. 9d.
These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

All Applications for Advertisements to be made to—

G. STREET & CO., Ltd., 8, Serle Street, London, W.C.

The back outside cover is not available for advertisements.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are

inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 56, Cornwall House, Stamford Street, S.E. 1.

Communications have been received from the following: Col. E. C. Freeman: Lieut.-Cols. E. M. Wilson, J. B. Crisp; A. E. Hamerton, G. Talbot, Esq.

The following publications have been received:—

British: Tropical Diseases Bulletin, Journal of the Royal United Service Institution, The Medical Press, The Medical Review, The St. Thomas's Hospital Gazette, The Medical Journal of Australia, Transactions of the Society of Tropical Medicine and Hygiene, The Journal of Tropical Medicine and Hygiene, The Medical Journal of South Africa, Guy's Hospital Gazette, The Journal of the Royal Army Service Corps, The Royal Engineers' Journal, The Practitioner, The Journal of State Medicine, Proceedings of the Royal Society of Medicine, Journal of the United Service Institution of India, The Indian Medical Gazette, St. Bartholomew's Hospital Journal.

Foreign: Bulletin de l'Institut Pasteur, Le Bulletin Médical, Journal of Agricultural Research, Washington, Archives de Médicine et Pharmacie Navales, The Journal of Infectious Diseases, Bulletin of the Johns Hopkins Hospital, Medicina Militar, Office International d'Hygiène Publique, Bulletin de la Société de Pathologie Exotique, The Military Surgeon, Journal of the Department of Public Health, Washington, Zeitschrift für Militärärzte Herausgegeben vom Sanitätscorps, The Dental Digest, Annali di Medicina Navale e Coloniale, Anales de la Dreccion de la Sanidad Nacional, Surgery, Gynæcology and Obstetrics, Tidskrift i Militär Hälsovard, The American Journal of Syphilis, L'Ospedale Maggiore.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," Cornwall House, Stamford Street, S.E. 1, and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,
"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"
CORNWALL HOUSE, STAMFORD STREET, S.E.1.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

MAY, 1920.

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
March 8, 1920.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign:—

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF THE BELGIANS.

Ordre de la Couronne.

Officier.—Temp. Major Cuthbert Christy, M.B., Royal Army Medical Corps.

Ordre de Leopold II.

Commandeur.—Lieut.-Col. Sir David Prain, Kt., C.M.G., C.I.E., M.B., F.R.S., Indian Medical Service (retired).

Médaille du Roi Albert.

Capt. Oswald Ryle Horwood, Australian Army Medical Corps.

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF THE HEDJAZ.

Order of El Nahda.

4th Class.—Temp. Capt. Graham Colville Ramsay, M.B., Royal Army Medical Corps.

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF ITALY.

Order of the Crown of Italy.

Commander.—Col. Charles Alfred Hodgetts, C.M.G., Canadian Army Medical Corps.
Officer.—Major Charles Bramhall, O.B.E., Royal Army Medical Corps.
Cavalier.—Capt. Percy R. Bolus, M.B., Royal Army Medical Corps (Territorial Force).

DECORATIONS CONFERRED BY THE PRESIDENT OF THE PORTUGUESE REPUBLIC.

Military Order of Aviz.

Commander.—Capt. John William McNee, D.S.O., M.B., Royal Army Medical Corps (Special Reserve); Col. Alexander D. Sharp, C.B., C.M.G., F.R.C.S., Army Medical Service (Territorial Force).

DECORATIONS CONFERRED BY THE PRESIDENT OF THE UNITED STATES OF AMERICA.

The Distinguished Service Medal.

Lieut.-Col. and Brevet Col. Sir Edward Scott Worthington, Kt., K.C.V.O., C.B., C.M.G., Royal Army Medical Corps.

War Office,
March 17, 1920.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign:—

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question:—

DECORATIONS CONFERRED BY THE PRESIDENT OF THE FRENCH REPUBLIC.

Légion d'Honneur.

Officier.—Major David Leonard Fisher, D.S.O., M.B., Royal Army Medical Corps (Territorial Force).

Croix de Guerre.

Capt. William Donald, M.C., M.B., Royal Army Medical Corps (Special Reserve).

Lieut. (Acting Major) Henry Goff Kilner, M.B., 5th Battalion Suffolk Regiment (Territorial Force) (attached Royal Army Medical Corps).

Temp. Capt. Henry Leslie Messenger, M.C., Royal Army Medical Corps.

147143 Pte. Norman Clarkson, 19th Company, Royal Army Medical Corps (formerly East Yorkshire Regiment) (Henley, near Huddersfield).

Ordre de l'Etoile Noire.

Officier.—Major John Humphrey Barbour, M.B., Royal Army Medical Corps; 495006 Staff-Serjt. Walter Frank Jenkins, Royal Army Medical Corps (Territorial Force) (Canterbury).

Médaille d'Honneur avec Glaives "en Vermeil."

Capt. William Victor Corbett, Royal Army Medical Corps.

Médaille d'Honneur avec Glaives "en Argent."

400094 Staff-Serjt. James William Drummond, Yorkshire Mounted Brigade Field Ambulance, Royal Army Medical Corps (Territorial Force) (Halifax).

11952 Serjt.-Major Albert Edward Malley, Royal Army Medical Corps (Southampton.)

388001 Temp. Serjt.-Major William Parker, Royal Army Medical Corps (Territorial Force) (Darlington).

Médaille d'Honneur avec Glaives "en Bronze."

527172 Cpl. (Acting Qmr.-Serjt.) Ronald William Dennis Beckett, Royal Army Medical Corps (Territorial Force) (Oakleigh Park).

512426 Serjt. Ernest Stanley Bourton, 2/3rd (London) Field Ambulance, Royal Army Medical Corps (Territorial Force) (Brixton, S.W.).

32707 Staff-Serjt. Arthur Edward Brown, Royal Army Medical Corps (Territorial Force) (Liverpool).

512187 Cpl. Ernest Samuel Crane, 2/3rd (London) Field Ambulance, Royal Army Medical Corps (Territorial Force) (Dalston, N.E.).

89678 Pte. George David Jefford 1/2nd (Lowland) Field Ambulance, Royal Army Medical Corps (Territorial Force) (Paris).

341570 Pte. Frank Patrick Jowett, 64th (2/3rd West Lancashire) Field Ambulance, Royal Army Medical Corps (Territorial Force) (Hale, Cheshire).

46764 Cpl. Herbert Knott, Royal Army Medical Corps (Territorial Force) (Sheffield).

29529 Cpl. Ernest Lidster, Royal Army Medical Corps (Territorial Force) (Walthamstow).

6367 Acting Lance-Cpl. Joseph Edward Luff, Royal Army Medical Corps (Long Sutton),

512245 Cpl. (Acting Lance-Serjt.) Frederick Wilson Lumley, 2/3rd (London) Field Ambulance, Royal Army Medical Corps (Territorial Force) (Bermondsey).

512231 Serjt. Perrin Oakenfull, 2/3rd (London) Field Ambulance, Royal Army Medical Corps (Territorial Force) (Westcliff-on-Sea).

512351 Cpl. Herbert Edward Rayson, 2/3rd (London) Field Ambulance, Royal Army Medical Corps (Territorial Force) (Northwood).

512191 Qmr.-Serjt. William Henry Stevens, 2/3rd (London) Field Ambulance, Royal Army Medical Corps (Territorial Force) (Golders Green).

Médaille des Epidémies (en Vermeil).

Capt. John Robert Crolius, Royal Army Medical Corps (Special Reserve).

Médaille des Epidémies (en Argent).

Capt. and Brevet Major Ernest Kelly, C.B., M.D., F.R.C.S., Royal Army Medical Corps (Territorial Force).

Capt. John Francis Roberts, M.B., Royal Army Medical Corps (Territorial Force).

508059 Temp. Serjt.-Major Frederick Albert Smith, 2/1st (London) Field Ambulance, Royal Army Medical Corps (Territorial Force) (Kensal Rise).

71974 Cpl. Archer Williams, 49th Casualty Clearing Station, Royal Army Medical Corps ("E" Newport, Mon.).

Central Chancery of the Orders of Knighthood.

St. James's Palace, S.W. 1.
March 30, 1920.

The King has been graciously pleased to give orders for the following promotions in, and appointments to, the Most Excellent Order of the British Empire, for services in connexion with the war, to be dated January 1, 1920:—

To be Knights Commanders of the Civil Divisions of the said Most Excellent Order:—

Major James William Beeman Hodsdon, C.B.E., M.D., F.R.C.S., Member of Medical Advisory Board, Ministry of National Service.

Brevet Lieut.-Col. David Wallace, C.M.G., C.B.E., M.B., F.R.C.S., Organizer and Consulting and Operating Surgeon, Dalmeny House Auxiliary Hospital; Red Cross Commissioner and Military Inspection Officer to Auxiliary Hospitals.

Brevet-Col. Arthur Lisle Ambrose Webb, C.B., C.M.G., Director-General Medical Services, Ministry of Pensions.

To be Commanders of the Civil Division of the said Most Excellent Order:—

Lieut.-Col. Sir James Barr, LL.D., M.D., F.R.C.P., F.R.S.E., County Director of Auxiliary Hospitals and Voluntary Aid Detachments in West Lancashire.

Col. William Coates, C.B., V.D., D.L., M.R.C.S., L.R.C.P., Chairman, East Lancashire Branch, British Red Cross Society.

Major Arthur de Winton Snowden, M.D., B.C., Senior Physician, British Red Cross Hospital, Netley.

To be Officers of the Civil Division of the said Most Excellent Order:—

Lieut.-Col. Richard Lane Joynt, M.D., F.R.C.S., Consultant for Orthopædic Workshops in Ireland, and other Red Cross Services.

Major Robert Arthur Milligan, M.D., M.R.C.S., J.P., Operative Surgeon, Barry Road Primary Military Hospital, Northampton.

Major John Murray, M.B., M.S., Medical Officer, Highland Moors and Rock Spa Military Hospitals, and other Red Cross Services.

Major James Bertie Simpson, M.D., T.D., D.L., valuable medical war service.

Major John Sterry, M.R.C.S., L.R.C.P., Assistant County Director, Sevenoaks Division; Medical Officer, St. John's V.A.D. Hospital, Sevenoaks.

Capt. John William Walker, M.R.C.S., L.R.C.P., Surgeon, Wentworth House Auxiliary Hospital, Wakefield.

Major William Young, M.B., C.M., V.D., Chairman of the Appeal and Civil Liabilities Sub-Committees, Midlothian War Pensions Committee.

To be a Member of the Civil Division of the said Most Excellent Order:—

Major Herbert Crowley Dent, Medical Officer, V.A.D. Hospital, Colne House, Cromer.

Central Chancery of the Orders of Knighthood.

St. James's Palace, S.W. 1.
March 31, 1920.

The King has been graciously pleased to give orders for the following appointments to the Most Excellent Order of the British Empire in recognition of services during the War. To be dated June 3, 1919, unless otherwise stated.—

To be an Officer of Military Division of the said Most Excellent Order:—

Canadian Forces.

Major F. J. Collings, Canadian Army Medical Corps. For valuable services rendered in connexion with military operations in Siberia.

Central Chancery of the Orders of Knighthood.

St. James's Palace, S.W. 1.
March 31, 1920.

Order of the British Empire.

Amendments.

The following amendments to the lists of appointments to the Most Excellent Order of the British Empire, announced in the *London Gazette* on the dates stated, are notified:—

Corrections to name: *London Gazette*, dated June 3, 1919.—Page 6796. For Temp. Qmr. and Capt. Sydney Thomas Beard, Royal Army Medical Corps, read Temp. Qmr. and Capt. Samuel Trevor Beard, Royal Army Medical Corps.

Corrections to Unit: *London Gazette*, dated June 3, 1919.—Page 6996. For Lieut. Raymond Barnett, R.A. (Territorial Force), read Lieut. Raymond Barnett, Royal Army Medical Corps.

Correction to rank.—London Gazette, dated June 3, 1919, page 6990. For Hon. Capt. Charles Henry Milburn, Royal Army Medical Corps (Territorial Force), read Hon. Major Charles Henry Milburn, Royal Army Medical Corps.

Other corrections.—*London Gazette*, dated December 12, 1919, page 15457. For Hon. Lieut.-Col. and Qmr. George Merritt, South African Medical Corps (to date December 12, 1919), read Hon. Lieut.-Col. and Qmr. George Merritt, M.B.E., South African Medical Corps (to date December 12, 1919).

War Office,
April 1, 1920.

AMENDMENTS.

The following are the correct descriptions of the undermentioned Warrant Officers and Men whose names have recently appeared in the *London Gazette* for the award of the Military Medal or Meritorious Service Medal :—

Military Medal.

London Gazette, dated February 4, 1918. 497539 Pte. E. Howe, 2/3rd (H.C.) Field Ambulance, Royal Army Medical Corps (Territorial Force).

The amendment in the *London Gazette*, dated December 18, 1919, should read :—
316357 Pte. W. Getgood, Royal Army Medical Corps.

Meritorious Service Medal.

London Gazette, dated June 17, 1918. 337443 Pte. T. H. Dinsdale, Royal Army Medical Corps.

London Gazette, dated January 18, 1919. 75961 Serjt. (Acting Warrant Officer, Class II) W. G. W. Hawkes, Royal Army Medical Corps.

London Gazette, dated February 22, 1919. 410194 Temp. Serjt.-Major R. Whitworth, Royal Army Medical Corps.

NOTES FROM ALDERSHOT :—

ARMY CUP.

Record of the Royal Army Medical Corps Team.

1st round	.. Bye	—
2nd ,,	.. *v.* 1st King's Royal Rifle Corps	Won 3—1
3rd ,,	.. *v.* 1st East Surreys	,, 3—1
4th ,,	.. *v.* No. 4 Motor Transport Depot, Royal Army Service Corps	,, 8—0
5th ,,	.. *v.* Army Gymnastic Staff	,, 1—0
6th ,,	.. *v.* 4th Dragoon Guards	,, 4—1
Semi-Final	.. *v.* 1st Seaforth Hussars	,, 2—0
Final ..	.. *v.* 1st Hants Regiment	,, 1—0

The following account of the final is taken from the *Aldershot News*, Friday, April 9, 1920.

"For the fourth time in its history the Army Cup has been won by an Aldershot team, the Royal Army Medical Corps winning the trophy on Easter Monday, when they met and defeated the 1st Hampshire Regiment by 1—0, on the Army Athletic Ground, in the presence of the King and Queen and a vast assemblage of spectators. It may be said at once that the victory was well merited, for although, during the first half hour, the Hampshires flattered their supporters with a remarkably clever display, during which they gave their opponents several anxious moments, the Medicals on the run of the game showed the better football, and held the balance of play.

"Some 12,000 spectators gathered on the Army Football Ground to witness the match, and they were treated to a very fine display of quick, clever football, void of any semblance of shady tricks and foul tactics, such as have disgraced professional football of late. Instead, the best characteristics of the Army's spirit of team play were shown throughout the match, and those who had the pleasure of witnessing the final could not but be delighted with the game.

"The ground was excellently arranged for the comfort of all. Huge enclosures on all sides gave clear view of the field of play, while in the centre of the western side a charmingly decorated, open-sided pavilion was erected for the convenience of the Royal visitors. In accordance with his long-established custom, His Majesty the King was present to see the final. He was accompanied by the Queen, Princess Mary, Prince Albert and Prince Henry, and on arrival from Windsor was received by Lieut.-Gen. Sir W. P. Pulteney, on behalf of the Army Football Association, and by Major-Gen. Sir Walter Campbell, in the absence of Gen. Lord Rawlinson, on behalf of the Aldershot Command.

"On the arrival of the Royal party in front of the pavilion the Royal Standard was broken from the flagstaff, and the Royal Artillery Mounted Band (who, with the massed pipers and drums of the Cameron and Argyll and Sutherland Highlanders, played before the match and at the interval) played the National Anthem. The crowd stood with heads bared as the King acknowledged the salute, and he bowed in pleased recognition of the rolling thunder of cheering that went up from the crowd.

"The cheering was renewed as the opposing teams ran on to the field, the Hampshires, as the pre-war finalists, leading. The teams lined up in front of the pavilion, the Hampshires on

the right, and each player in turn was presented to the King, who shook hands with each, and smilingly wished each team the best of luck.

"The day was overcast, with short showers prevailing, but with the exception of a brief, light shower in the opening stages of the game, no rain fell during play. Tho turf was in excellent condition, the heavy rains of the previous few days having drained away, leaving the grass firm and springy. No time was lost in preliminaries, and, after the spin of the coin, the teams faced each other in the following order:—

"Royal Army Medical Corps: Qmr.-Serjt. F. G. Quelch; Ptes. Webberley and Osborne; Pte. Howarth, Serjt. Sims and Cpl. Plunkett; Pte. Humphries, Serjt.-Major Prince, Pte. Davies, Pte. Crowther and Pte. Coombs.

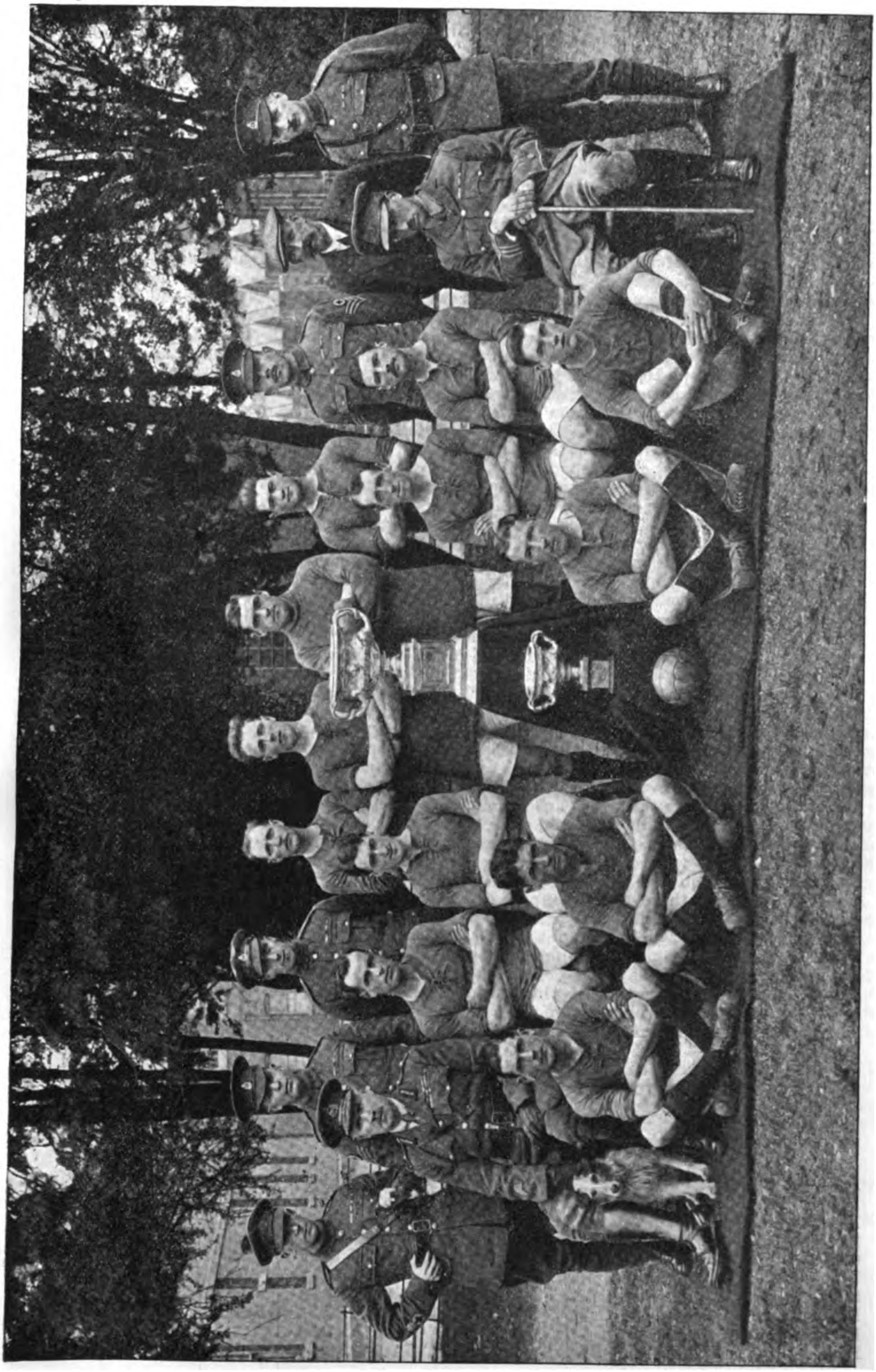
"1st Hampshire Regiment: Lieut. P. A. Terrey; Coy.-Qmr.-Serjt. V. Bartlett and Cpl. Rowlands, Serjt. T. Clifford, Serjt. H. Herrington and Cpl. A. Hinchy, Serjt. A. Martin, Lance-Cpl. Prouse, Pte. McCarthy, Coy.-Qmr.-Serjt. Blackwell and Pte. Sweet.

"Referee: Major W. C. Clover, Leicester Regiment.

"Linesmen: Lieut. Old, R.F.A., and Regt.-Qmr.-Serjt. Beck, Northumberland Fusiliers.

"The Medicals were undoubtedly the superior team, but they did not have a runaway victory, the Tigers being game to the last. As usual, the Corps took some time to settle down, and in consequence the county team had the best of matters for the greater part of the first half. The only goal of the match was scored three minutes from the restart by Humphries, amidst great excitement. Half-way through the second half the Hampshires' play began to slack away from the fine combination and vigorous attack which had been so prominent a feature of the opening stages, and the Medicals' defence, although tested on several occasions, proved too good for the opposing forwards.

"Serjt.-Major Prince, a fine, all-round athlete, and amateur international footballer, captained the Corps team, but was not on the top of his form, still suffering from old injuries. He had an able partner on the right wing in Humphries. Once the team settled down to their quick, low passing they combined so thoroughly that it is difficult to single out any player for special praise—the half-backs were clever, in both attack and defence, and the backs and goalie always rose to the occasion when the Hampshires were dangerous. Osborne played his customary fine game at left back. Conspicuous amongst the losing team were Serjt. Herrington, the centre-half, and Pte. Sweet, the left winger. The latter, a diminutive player, has a fine



turn of speed, and whenever he got away he sent in good centres. Nearly all the danger to the Medicals' goal came from this direction.

"The Medicals kicked off, but did not get far beyond the half-way line, the Hampshires gaining possession of the ball and vigorously attacking. Osborne, however, cleared from Prouse, and in a subsequent forward movement that looked very dangerous, Blackwell overran the ball. Sims got away and passed to Coombs, who was beaten by Bartlett. The ball again went to the Medicals' end, but Quelch had no difficulty in stopping a breast-high shot by McCarthy. The Hants kept up the pressure, and after Osborne had headed the ball away from a pretty centre by Blackwell, Prouse sent the ball over the cross-bar. Humphries got away on the right, and after some pretty passing between him and Prince, Rowlands sent the ball out of the ground in clearing. Prince regained the ball after a miskick by McCarthy, and passed out to Humphries, whose shot Rowlands cleared. The Corps got the ball away from a corner, but the Hants pressed, and Quelch cleared just in time. Osborne sent the ball up the field and Davies came very near scoring, Humphries shooting wide just after. Sweet, after a pretty run up on the wing, kicked the ball too far forward, and Quelch ran out and sent it out of danger. Blackwell tested Quelch with a very hot shot, which, however, the goalie had no difficulty in catching and clearing. Martin, the Hampshire's right winger, was applauded for the clever way in which he took the ball from Osborne after falling to the ground. The Medicals' attacks were succeeding, and Terrey effected a good save from Davies, who sent in a hot shot. A minute later Davies made another fine attempt, and this time the goalie conceded a corner in saving. From the corner kick Sims shot just wide of the goal.

"The teams changed over without score, but play had only been resumed a few minutes when Humphries scored what proved to be the one and only goal of the match, and won for the Medicals the coveted trophy. It was a close range first-time shot, which left Terrey not the ghost of a chance. Good half-back play led up to the score, the ball going out to the left, where Coombs, beating his half, whipped the ball across to the right, a dozen yards in front of goal. The Hampshire defence saw it sailing to Prince's foot, and, realizing the danger, made a desperate rush to stop him shooting. But, with characteristic presence of mind, Prince simply tapped the ball over to Humphries, who, with a first-time left foot shot, sent it like a flash of lightning into the net, a few inches above the ground.

"This success raised a storm of applause for it was so cleverly worked for, and so well merited, that supporters of both teams joined in the applause. From then onwards the Medicals dominated the game, and the Hampshires' goal had a narrow escape when Crowther sent the ball right across, a few feet from the uprights. They broke away, and Osborne conceded a corner that failed to materialize. Crowther passed out to Coombs, from whose centre Prince headed and missed the net. For some minutes the Medicals were repeatedly dangerous, but Terrey and the backs managed to prevent them from making the issue more certain. The Tigers made a plucky attempt to equalize in the last minutes of the game, and a sensational left wing attack all but brought success. A clever run by the left wing put Sweet in possession near the corner flag, and he sent across a centre that Quelch saved in remarkably clever fashion as the centre-forward arrived with a most determined rush, a fraction of a second too late. That was the last incident in a well-contested game, and, while congratulating the victors on a well-merited win, one must sympathize with the fate of the Hampshires, who have, in two successive finals, lost the trophy by a single goal each time.

After the match there was a stampede of the thousands of spectators from all parts of the ground to see the cup and medals presented. The teams were somehow squeezed through the crowd, and were lined up in front of the Royal enclosure, this time with the Medicals on the right. The Royal visitors came out on to the ground, and His Majesty complimented both teams on the fine game they had played and on the good sporting spirit displayed. He then presented the handsome challenge cup and its replica to the winning team, and Her Majesty presented medals to each player. Hearty cheers were given for their Majesties before the teams left, Prince being shouldered, with the cup, in the midst of his comrades, and borne in triumph to the dressing room."

PARTICULARS OF THE TEAM.

Rank	Name	Date of enlistment	Age	Position
Qmr.-Serjt.	Quelch, F. G.	13.6.06	28	Goalkeeper
Pte.	Webberley, G.	26.3.14	20	Right Back
Pte.	Osborne, R.	1.11.12	21	Left Back
Pte.	Howarth, H.	14.1.14	28	Right Half Back
Serjt.	Sims, J. R.	25.10.09	29	Centre Half Back
Cpl.	Plunkett, A. E.	16.1.14	26	Left Half Back
Pte.	Humphries, F. L.	17.1.14	26	Right Outside
Serjt.-Major	Prince, H. M.	14.10.07	28	Right Inside
Pte.	Davies, C. J.	19.8.19	29	Centre Forward
Pte.	Crowther	16.2.11	24	Left Inside
Pte.	Coombs, E.	12.9.19	18	Left Outside

WINNERS OF THE NAVY CUP *v.* WINNERS OF THE ARMY CUP.

The above match was played on the Navy Ground, Royal Naval Depot, Chatham, on Wednesday, April 21, 1920, before a good number of spectators, of whom a good many made the journey from Aldershot.

The teams competing were the Corps team and the R.M.L.I. Chatham.

The ground was in a very wet and heavy condition, and, considering the same, the Corps team played excellent football, being much superior to the Marines.

Prince won the toss, and elected to take advantage of the wind. The game was only five minutes old when the Corps scored through Prince. No more scoring took place until about twenty minutes from half-time, when Prince converted a perfect centre from Humphries; this was followed by one from Williams, and then Prince obtained the fourth and his third goal from a very long shot, which the goalkeeper partially stopped, but failed to hold.

Webberley, in attempting to clear, headed the ball into his own goal, thus giving the Marines their first goal, which was the finish of the scoring in the first half.

The second half was much more strenuous for the Corps, as they were without Crowther, who was unable to turn out owing to an injury to his ankle.

In spite of this handicap, the Corps had quite as much of the game as the Marines; each side added a goal to their totals, the final whistle sounding with the score 5 goals to 2 in favour of the Corps.

This fixture was the first of its kind, and is to be an annual affair to be played alternately on a Navy and Army ground.

At the conclusion of the match General Harrington presented the Cup to the winners, and in his speech he specially congratulated the Corps team on being the first team to win the Cup, he dwelt on the fact that the game had been played in such a good sporting spirit, and he hoped in the future that people would look up to the Services as an example for this quality.

The Corps Team have the following Cup ties to play.

Semi-Final	..	..	Aldershot Charity Cup
Final ..	..	..	,, Senior Cup
,, ..	..	..	,, Command Senior Competition
Semi-Final	..	..	Russell-Cotes Benevolent Cup

NOTES FROM DEVONPORT.—Serjt.-Major Robinson writes:—

"NO. 7 COMPANY, ROYAL ARMY MEDICAL CORPS, DEVONPORT.

"The Football season having just terminated, a short retrospect would probably be interesting. Having in view the heavy depletion of staff (caused by demobilization) we were fortunate in having a fairly successful season, playing in all twenty matches. This sport afforded many opportunities of drawing the men together in the bond of friendship and sport. The following is an extract from Plymouth Garrison Orders: 'Great credit is due to No. 7 Company, Royal Army Medical Corps, for having played all their matches.' This referred to the Garrison Football League, and No. 7 Company ended up with third place. The headquarters of the Company being situated on the water's edge, a boat was purchased for their use and many pleasant trips have been made, combined with good exercise, which have been largely appreciated by the men. The Commanding Officer (Lieut.-Col. N. Tyacke, Royal Army Medical Corps) has again come forward in giving every assistance to enable the Company to form a cricket team, and there is every hope of a prosperous season in view, the garrison ground being allotted equally to all Units.

"A most successful dance, organized by the Serjeants' Mess under the able committee of Serjt.-Major Robinson, Qmr.-Serjt. Rouse, and Serjts. Phillips and Crossman, took place in the Garrison Gymnasium on April 30, 1920, and it was unanimously agreed by Naval, Military and civilian friends that it was the best dance given for the season. The guests totalled 320, and the duties of M.C. were admirably performed by Staff-Serjt. Joyce and Serjt. Truscott, who strictly complied with dance etiquette.

"The rapid demobilization during the past few months has claimed many members from the Serjeants' Mess and each one in turn has had a hearty send off in the form of a Smoking Concert.

"Demobilization of the Company was satisfactorily completed by April 30, 1920, with the exception of two men who were in hospital. Civil subordinates replaced fifty per cent of the Royal Army Medical Corps who were demobilized, and are at present working most satisfactorily.

"Capt. and Qmr. F. O. Chappel, Royal Army Medical Corps, arrived for duty on April 6, 1920, in relief of Capt. and Qmr. W. Storey, Royal Army Medical Corps, who proceeded to Egypt for duty on April 28, 1920.

"A course of Lectures and Promotion Classes are now in an advanced stage, and there are good prospects of good and efficient non-commissioned officers forthcoming."

ROYAL ARMY MEDICAL CORPS DINNER, 1920.

THE Annual Dinner of the Officers of the Royal Army Medical Corps will take place on Monday, June 14, 1920, in the "Wharncliffe Rooms," Great Central Hotel, Marylebone, N.W.1, at 7.45 p.m. President: The Director-General, Army Medical Service.

The price of dinner tickets to subscribers will be 7s. 6d. The price to non-subscribers will be £2 12s. 6d.

It is particularly requested that early application for tickets be made, both by subscribers and non-subscribers, in order that the number attending may be approximately known as soon as possible. Non-subscribers, when applying for tickets, should forward the sum of £2 12s. 6d. by cheque or P.O.O., made payable to the Honorary Secretary. The price of the dinner ticket will be collected from subscribers at the Restaurant on the night of the Dinner.

The following Officers will be regarded as subscribers:—

(1) All existing subscribers to the old Royal Army Medical Corps Dinner Fund, provided they have paid their subscriptions to that Fund for the current year.

(2) All subscribers to the Royal Army Medical Corps Fund, provided their subscriptions are credited to the Fund before the date of the Dinner. Officers who have specially excluded the Annual Dinner in the allocation of their subscription will, of course, be excepted. It has been decided that, with the exception of Mr. Vesey Holt, no guests will be invited.

Selected musicians from the Royal Army Medical Corps Band will perform during Dinner.

Besides one long table, there will be small separate tables to allow of eight Officers sitting at each, and these will be reserved for parties of eight Officers who wish to dine together, if they will arrange to notify the names to the Honorary Secretary before Thursday, June 10.

A plan of the tables will be on view at the Restaurant on the day of the Dinner, in order that Officers who have not made up parties may select the places at which they wish to sit. A list of Officers who have notified their intention of dining will also be on view,

N.B.—The Monday in Ascot week has been fixed as the day on which the Dinner will be held each year.

Dress.—Evening dress.

Miniature medals will be worn.

Cornwall House,
Stamford Street, S.E. 1.

A. R. WRIGHT, *Captain, R.A.M.C.,*
Hon. Secretary, Royal Army Medical Corps Annual Dinner Committee.

ROYAL ARMY MEDICAL CORPS FUND.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT CORNWALL HOUSE, STAMFORD STREET, ON APRIL 14, 1920.

Present.

Lieut.-Gen. Sir T. H. J. C. Goodwin, K.C.B., C.M.G., D.S.O.. K.H.S., Director-General, in the chair.

Major-Gen. Sir G. B. Stanistreet, K.B.E., C.B., C.M.G., Deputy Director-General.
Major-Gen. Sir W. Donovan, K.C.B.
Col. C. R. Tyrrell, C.B., C.B.E.
Lieut.-Col. A. B. Cottell.
Major P. G. Easton, C.B.E., D.S.O.
Major E. P. Offord.
Capt. E. B. Allnutt, M.C., Band President.

(1) A letter of regret for absence was read from Sir J. Magill.

(2) The minutes of the meeting held on January 21, 1920, were read and confirmed.

(3) *Band.*—(*a*) The Secretary reported payment of £100 previously authorized.

(*b*) The Band President submitted the accounts for the quarter ending March 31, 1920, which were approved, and also the application for a further grant of £100 if and when required.

(*c*) Capt. Allnutt proposed that the salary of the Band Master should be raised from £150 to £170 a year in order to meet the increased cost of living. This was approved to take effect from April 1, 1920.

(4) *Dinner.*—(*a*) The report of the Dinner Sub-Committee was read as follows:—

The Committee Royal Army Medical Corps Dinner Fund report as follows:—

(i) The Dinner in 1919 was held at the Savoy Hotel on June 11 when 286 past and present officers of the Corps attended, this total including a large number of guests invited from the temporary officers of the Corps, Special Reserve and Territorial Force, who served with the Royal Army Medical Corps during the war. H.R.H. Field Marshal the Duke of Connaught, Colonel-in-Chief, presided at the Dinner.

(ii) It was decided that the Dinner this year be held on June 14, at 7.30 for 8 p.m., the Dinner Sub-Committee to carry out the arrangements for the selection of a suitable restaurant, etc.

(iii) They recommend that the charge for tickets to subscribers be 7s. 6d., and to non-subscribers £2 12s. 6d., a grant being voted from the Royal Army Medical Corps Fund to defray the balance.

(iv) The following officers have been nominated to serve on the Dinner Committee :—

Col. J. A. Hartigan, C.M.G., D.S.O., representing Aldershot.
Major F. A. Stephen, representing Netley.
Major H. S. Dixon, representing Woolwich.

(v) The number of officers subscribing to the Old Dinner Fund during 1919 was fifteen.

The report was approved and also the accounts for the year 1919.

(*a*) It was decided to hold the Dinner at the Wharncliffe Rooms, Great Central Hotel, on June 14, 1920, at 7.30 for 8 p.m., and certain points were referred to the Sub-Committee for arrangement.

(*b*) It was noted that a letter had been received stating that H.R.H. the Colonel-in-Chief would be unable to be present at the Dinner this year.

(5) *Memorials.*—The question of completing the collection of V.C. pictures at the Royal Army Medical College Mess, Grosvenor Road, S.W., was considered, and referred to the Memorial Sub-Committee to make the necessary investigations and report to the Annual General Meeting in June.

(6) *General Relief.*—Twelve small grants made in urgent cases under Rule 9 amounting to £39 were approved, and additional grants authorized under Rule 8 as follows :—

Wife and children of J. B., husband being in an asylum ..	£3	0	0
Mr. and Mrs. F. W. C., old age and infirmity	3	0	0
Widow and children of the late D. L.	3	0	0
H. W. B., wife and four children ; husband invalid and unable to work	3	0	0
J. M. and family ; husband under treatment at a sanatorium ..	2	0	0

(7) The Secretary reported the following donations since the last meeting :—

December 30, 1919.	R.A.M.C., Sheffield, "C" Section	£5	0	0
*January 14, 1920.	91st Field Ambulance, by Capt. Alan Wilson..	36	6	0
*February 2, 1920.	No. 2 Stationary Hospital, France, for Schools..	22	18	5
*February 2, 1920.	R.A.M.C. Depot part of surplus of R.A.M.C. Magazine	67	10	0
*February 4, 1920.	United Services Trustee from Units in France..	201	15	9
*February 9, 1920.	United Services Trustee, Training Centre, Ripon	16	4	3
*February 17, 1920.	United Services Trustee, 62nd General Hospital	51	8	7
*February 17, 1920.	32nd Combined Clearing Hospital, Egypt, by Col. Cahill	20	0	0
*February 22, 1920.	Balance of Taylor Memorial, by Col. Tyrrell ..	1	0	0
*March 11, 1920.	United Services Trustee from 31st Division ..	50	0	0
		£472	3	0

* Proportion allotted to this Fund of larger cheques received, the balances having been allotted by donors to other Funds.

(8) It was proposed by Lieut.-Col. A. B. Cottell and carried that it be recommended to the Annual General Meeting that in Rules 8 and 9 the words "not exceeding £6" be altered to "not exceeding £10" so as to admit a somewhat larger grant being made to families in cases of urgent necessity.

(9) *Schools.*—Applications were considered for renewal of grants for schools at which children of N.C.O.s and men of the Corps are being educated, and the following authorized :—

(*a*)

Royal Drummond Institute, Dublin, two children	£12	0	0
Destitute Catholic Children, Compton Street, one child ..	10	0	0
Convent of St. Vincent de Paul, one child (part payment only)	3	0	0

(*b*) The Secretary reported the receipt of a donation of £22 18s. 5d., specially allocated to Education from No. 2 Stationary Hospital.

(10) *General.*—The accounts for the year 1919 which have now been audited were passed for presentation to the Annual General Meeting.

(11) The draft of the annual report was considered and approved.

(12) It was proposed by Sir W. Donovan and seconded by Col. C. R. Tyrrell that the Commandant be requested to nominate a Professor of the Royal Army Medical College to fill the vacancy on the Committee caused by the retirement of Sir W. H. Horrocks.

(13) The date of the Annual General Meeting was fixed for June 14, 1920, to take place at the Royal Army Medical College at 3 p.m.

(14) It was decided to recommend the re-appointment of Lieut.-Col. E. M. Wilson as Secretary for one year from June 14, 1920, at the salary recommended by the last meeting.

ROYAL ARMY MEDICAL CORPS DINNER FUND.

Balance Sheet and Statement of Accounts for the year ending December 31, 1919.

1919.		RECEIPTS.	£	s.	d.
Jan. 1.	By	Balance—Holt and Co.	18	16	0
,,	,,	Cash in hand	0	8	5½
June.	,,	Cheque from Secretary, R.A.M.C. Fund, in settlement of Savoy Hotel's account	659	2	6
,,	,,	Cash collected—Savoy Hotel	55	17	6
,,	,,	Subscriptions—Holt and Co.	12	15	0
,,	,,	Cheque from Secretary, R.A.M.C. Fund	40	0	0
,,	,,	,, ,, ,, ,,	10	0	0
,,	,,	Cash (to Postage account)	0	7	6
Dec. 31.	,,	Balance drawn Holt and Co.	1	10	3
			£798	17	2½

1919.		EXPENDITURE.	£	s.	d.
June.	To	Savoy Hotel—R.A.M.C. Fund Dinner	715	0	0
,,	,,	Stationery and Printing (Army and Navy Stores)	10	17	8
,,	,,	Printing (Bale and Danielsson) ..	1	16	9
,,	,,	Advertisements—*Times*	6	11	0
,,	,,	,, *Morning Post* ..	3	11	0
,,	,,	,, May and Williams ..	8	17	7
,,	,,	Conveyance of Plate—Aldershot ..	0	14	6
,,	,,	,, ,, London	5	15	0
,,	,,	Band Expenses	7	0	0
,,	,,	Cigars and Cigarettes (Army and Navy Stores) ..	27	8	4
,,	,,	,, ,, (Conveyance and Custody, Mr. Myles)	1	1	1
,,	,,	Clerical Assistance	5	0	0
,,	,,	Cheque Book	0	8	4
,,	,,	Postage and Expenses	4	14	4½
Dec. 31.	,,	Cash in hand	0	1	7
			£798	17	2½

Cornwall House,
Stamford Street, S.E. 1.
March 24, 1920.

Audited and certified correct,
(*Signed*) J. R. McMUNN,
Colonel A.M.S.

ROYAL ARMY MEDICAL CORPS BAND.

Statement of Accounts, January to March, 1920.

Receipts.	£	s.	d.	Expenditure.	£	s.	d.
Brought forward	106	8	3	Salaries	45	1	0
Fares repaid for Travelling Expenses	8	11	0	Band Pay	79	2	3
Grant from R.A.M.C. Fund	100	0	0	Fares for Travelling	5	8	6
Band Engagements	5	0	0	Music and Repairs to Instruments	8	16	8
From R.A.M.C. Mess, Aldershot	3	3	0	To Bandsmen for Engagements	4	0	0
				Total expenditure	£142	8	5
				Balance in hand	80	13	10
	£223	2	3		£223	2	3

Crookham Camp, Aldershot,
March 3, 1920.

E. B. ALLNUTT, *Captain and Adjutant,*
Depot R.A.M.C., Band President.

Audited and found correct.

R. F. WALKER, *Capt. R.A.M.C.*
G. E. CORRALL, *Lieut. R.F.*

ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT CORNWALL HOUSE, STAMFORD STREET, ON APRIL 14, 1920.

Present:

Lieut.-Gen. Sir T. H. J. C. Goodwin, K.C.B., C.M.G., D.S.O., K.H.S., Director-General, in the Chair.
Major-Gen. Sir W. Donovan, K.C.B., one of the Trustees.
Major-Gen. Sir M. W. Russell, K.C.M.G., C.B.
Major-Gen. Sir H. R. Whitehead, K.C.B.
Col. A. Peterkin, C.B.
Lieut.-Col. A. B. Cottell.

(1) The minutes of the meeting held on January 21, 1920, were read and confirmed.

(2) Letters of regret for absence were read from Col. H. W. Murray and Capt. J. T. Clapham.

(3) Five (5) grants which had been made in very urgent cases under Rule 31 were submitted and approved.

(4) Further correspondence was read from Solicitors in Scotland regarding a bequest which will eventually accrue to the Society, and it was decided to agree with the proposal of the Trustees to realize the Trust investments with a view to meeting the legacies as far as possible, in accordance with the wishes of other charitable and benevolent societies to whom legacies have been left under the same will.

(5) The Secretary reported that 300 copies of the blue form of application had been printed as revised by the Sub-Committee appointed at the last meeting at a cost of £3 14s. 6d. Approved.

(6) Grants and Donations received since last meeting were reported as follows:—

DONATIONS SINCE LAST MEETING.

1920		£	s.	d.
January 14.	No. 4 General Hospital, Officers' Mess, by Major W. S. Crosthwait	6	16	0
January 15.	Major G. R. Painton	5	0	0
*February 2.	R.A.M.C. Depot Magazine on closing	22	10	0
*February 7.	32nd Comb. Clearing Hospital, Egypt, by Col. Cahill	20	0	0
*February 9.	United Services Trustee, part of cheque from R.A.M.C. Training Centre, Ripon	2	18	4
February 24.	Lieut.-Col. A. S. Rose	10	10	0
March 18.	Mrs. MacBean and Miss Allan	5	0	0
March 18.	Bethnal Green Military Hospital, by Capt. C. P. S. Allingham	11	17	5
		£84	1	9

* Proportion allotted to this Fund of larger cheques received, the balances of which have been allotted by the Donors of other Funds.

(7) The Secretary reported that up to the present time 122 additional officers had joined the Society in consequence of the appeal sent out by the Committee in connection with the centenary of the Fund, also that the present cash balance at the Bankers amounted to £1,015 9s.

(8) Thirty-five applications for assistance were considered and grants were recommended for decision by the Annual General Meeting.

(9) The accounts for the year 1919 which have now been audited, were examined prior to their submission to the Annual General Meeting.

(10) The Draft for the Annual Report was considered and approved.

(11) The Committee decided to recommend the re-appointment of Lieut.-Col. E. M. Wilson as Secretary for one year from June 14, 1920, at the salary recommended at the last meeting.

UNITED SERVICES MEDICAL SOCIETY.

THERE will be a meeting of the United Services Medical Society in the library of the Royal Army Medical College, Grosvenor Road, S.W., at 3.30 p.m. on May 28, 1920, to discuss the proposed amalgamation of the Society with the War Section of the Royal Society of Medicine.

ROYAL COLLEGE OF SURGEONS IN IRELAND.

THE President, Vice-President and Council have elected Professor Grafton Elliott Smith, M.A., M.D., F.R.C.P., F.R.S., to the Mary Louisa Prentice Montgomery Lectureship in Ophthalmology. The subject of his first lecture will be "The Influence of Stereoscopic Vision on the Evolution of Man." The lecture will take place in October, 1920.

ROYAL ARMY MEDICAL COLLEGE.

LIST OF BOOKS ADDED TO THE LIBRARY DURING THE MONTHS OF JANUARY, FEBRUARY AND MARCH, 1920.

Title of Work and Author	Edition	Date	How obtained
Index Generalis Annuaire Général des Universités ..		1919	Library Grant.
Human Vitality and Efficiency under Prolonged Restricted Diet. By Francis G. Benedict, and others		1919	,, ,,
A Handbook of Colloid-Chemistry. By Dr. W. Ostwald. Translated by M. H. Fischer	2nd	1919	,, ,,
A Text-Book of Bacteriology. By Hill and Zinsser ..	4th	1919	,, ,,
The Feeding of Nations. By E. H. Starling, C.M.G., F.R.S.		1919	,, ,,
Milk. By Paul Heineman, Ph.D.		1919	,, ,,
Practical Sanitation. By G. Reid, O.B.E., M.D... ..	19th	1919	,, ,,
Methods of Air Analysis. By J. S. Haldane, F.R.S. ..	2nd	1918	,, ,,
The Welfare of the School Child. By Joseph Cates, M.D. English Public Health Series		1919	,, ,,
The Chemistry of Colloids. By R. Zsiqmoucly. Translated by E. B. Spear, B.A.		1917	,, ,,
The National Association for the Prevention of Tuberculosis. Transactions of the Seventh Annual Conference		1919	,, ,,
The Amoebae Living in Man. By Clifford Dobell, F.R.S.		1919	,, ,,
Infection and Resistance. By Hans Zinsser, M.D. ..	2nd	1918	,, ,,
More Minor Horrors. By A. E. Shipley		1916	,, ,,
The Diagnosis and Treatment of Heart Disease. By E. M. Brockbank, M.D.	4th	1919	,, ,,
The Sanitary Inspector's Handbook. By Albert Taylor..	5th	1914	,, ,,
Chemistry of Food and Nutrition. By Henry C. Sherman, Ph.D.	2nd	1919	,, ,,
A Physician in France. By Major-General Sir Wilmot Herringham, K.C.M.G., C.B.		1919	,, ,,
The Great War and the Royal Army Medical Corps. By Brevet Lieut.-Col. F. S. Brereton, R.A.M.C.		1919	,, ,,
A Practical Study of Malaria. By W. H. Deaderick, M.D.		1909	Editor, Journal.
Psychoses of the War, including Neurasthenia and Shell Shock. By Lieut.-Colonel H. C. Marr, M.D., R.A.M.C.		1919	,, ,,
Venereal Disease: its Prevention, Symptoms and Treatment. By Hugh Wansey Bayly, M.C.		1920	,, ,,
Handbook of Anæsthetics. By J. S. Ross, M.B... ..		1919	,, ,,
Nerve Injuries and their Treatment. By Purves Stewart and Arthur Evans	2nd	1919	,, ,,
Defects found in Drafted Men, Statistical Information Compiled from the Draft Records, showing the Physical Condition of the Men Registered and Examined in pursuance of the requirements of the Selective Service Act. Prepared under the direction of the Surgeon-General M. W. Ireland, M.C., U.S.A. By Lieut.-Col. G. Love and Major C. B. Davenport		1919	,, ,,
Report of the Surgeon-General, United States Army, to the Secretary of War, 1919. Vol. ii		1919	,, ,,
The Lister Institute of Preventive Medicine. Collected Papers. No. 14. Parts 1 and 2		1917-18	,, ,,
National Health Insurance. Medical Research Commitee. Special Report Series :—			
No. 46. An Investigation into the Epidemiology of Phthisis in Great Britian and Ireland		1920	,, ,,

LIST OF BOOKS ADDED TO THE LIBRARY—*Continued.*

Title of Work and Author	Edition	Date	How obtained
National Health Insurance. Medical Research Committee. Special Report Series :—			
No. 47. The Accuracy of Wassermann Tests, Applied before and after Death, estimated by Necropsies; (1) The Wassermann Test Applied before Death		1920	Editor, Journal.
No. 48. A Report on the Probable Proportion of Enteric Infections among Undiagnosed Febrile Cases invalided from the Western Front since October, 1916		1920	,, ,,
Chemistry for Public Health Students. By E. Gabriel Jones, M.Sc., F.I.C.		1920	,, ,,
Fifty-fifth Annual Report of the Sanitary Commissioner for the Government of Bombay, 1918. With Appendices		1919	India Office.
Fifty-fifth Annual Report of the Sanitary Commissioner, Madras, 1918		1919	,, ,
Annual Vaccination Report for the Province of Assam, 1918-19		1919	,, ,,
Report on the Sanitary Administration of the North-West Frontier Province :—			,, ,,
For the year 1917		1918	
For the year 1918		1919	
Report on the Statistical Returns of the Provincial Lunatic Asylum in Assam for the year 1918		1919	,, ,,
Dispensary Returns of the Province of Assam for the year 1917. With brief Explanatory Notes		1918	,, ,,
Annual Vaccination Returns for the Province of Assam for the year 1917-18		1918	,, ,,
Report of the Bombay Bacteriological Laboratory for the year 1918. By Lieut.-Col. W. Glen Liston, C.I.E., I.M.S.		1919	,, ,,
Report of the Chemical Examiner to the Government of Burma :—			
For the year 1917		1918	,, ,,
For the year 1918		1919	,, ,,
Notes and Statistics for Hospitals and Dispensaries in Burma :—			
For the year 1917		1918	,, ,,
For the year 1918		1919	,, ,,
Report on the Working of the Burma Government Medical School, Rangoon :—			
For the year 1917-18		1918	,, ,,
For the year 1918-19		1919	,, ,,
Report on the Lunatic Asylums in Burma for the Triennium, 1915-17		1918	,, ,,
Note on the Lunatic Asylums in Burma for the year 1918		1919	,, ,,
Notes and Statistics on Vaccination in Burma :—			
For the year 1917-18		1918	,, ,,
For the year 1918-19		1919	,, ,,
Report on the Sanitary Administration of Burma :—			
For the year 1917		1918	,, ,,
For the year 1918		1919	,, ,,
Notes on Vaccination in the Bombay Presidency for the year 1917-18		1918	,, ,,
Annual Report on Civil Hospitals and Dispensaries in Bombay for the year 1917		1918	,, ,,
Fifty-fourth Annual Report of the Sanitary Commissioner for the Government of Bombay, 1917. With Appendices		1918	,, ,,
Fifty-fifth Annual Report of the Sanitary Commissioner for the Government of Bombay, 1918. With Appendices		1919	,, ,,
Journal of the Royal Naval Medical Service, January ..		1920	The Editor.
The *Kitasato Archives of Experimental Medicine*. Vol. iii, No. 2		1919	The Director.

LIST OF BOOKS ADDED TO THE LIBRARY—*Continued.*

Title of Work and Author	Edition	Date	How obtained
The *Japan Medical World*, December 7, 1919, to January 24, 1920		1919-20	The Director.
The *Medical Officer*, January 3 to March 27		1920	The Editor.
Proceedings of the Royal Society. Series B. Vol. xci. No. B. 637		1920	Royal Society.
Man: a Monthly Record of Anthropological Science, January, February and March		1920	Presented by Col. S. L. Cummins, C.B., C.M.G.
The *Geographical Journal*, December, 1919, to March, 1920		1919-20	Presented by Col. R. J. S. Simpson, C.B., C.M.G.
Diets and Articles of Food suitable for Diabetic Patients. By R. T. Williamson, M.D.		1919	Presented by the Author.
A Manual of War Surgery. By Barling and Morrison ..		1919	Presented by Col. H. Burrows, A.M.S.
Injuries of the Superior Longitudinal Sinus. (Reprint.) By Gordon Holmes, M.D., and Percy Sargent, M.B.		1915	Presented by Lieut.-Col. Gordon Holmes, C.M.G., C.B.E., M.D.
On Spinal Injuries of Warfare. (Reprint.) By Gordon Holmes, M.D.		1915	,, ,,
The Symptoms of Acute Cerebellar Injuries due to Gun-shot Injuries. (Reprint)		1917	,, ,,
Disturbances of Vision by Cerebral Lesions. (Reprint.) By Gordon Holmes, C.M.G., M.D.		1918	,, ,,
Disturbances of Spatial Orientation and Visual Attention, with Loss of Stereoscopic Vision. (Reprint.) By Holmes and Horrax		1919	,, ,,
La Direction du Service en Campagne. Par Médecin Principal Troussaint		1911	Presented by Col. C. H. Melville, C.M.G.
Turnvorschrift für die Infanterie		1895	,, ,,
Alcohol and the Human Body. By Sir Victor Horsley and Mary D. Sturge	5th	1915	Presented by Lieut.-Gen. Sir W. Babtie, V.C., K.C.B., K.C.M.G.
Prevention of Disease and Inefficiency. By Lieut.-Col. Patrick Hehir, I.M.S.	2nd	1911	,, ,,
The March: its Mechanism, Effects and Hygiene. By Lieut.-Col. Patrick Hehir, I.M.S.		1912	,, ,,
Hygiene and Diseases of India. By Lieut.-Col. Patrick Hehir, I.M.S.	3rd	1913	,, ,,
On Modern Methods of treating Fractures. By Ernest W. Hey Groves		1916	,, ,,
Notes on Military Orthopædics. By Col. Robert Jones, C.B.		1917	,, ,,
Military Sanitation and Hygiene. By Capt. E. Blake Knox, R.A.M.C.		1911	,, ,,
Le Paludisme et les Moustiques (Prophylaxie). Par André Pussat		1905	,, ,,
Third Report of Wellcome Research Laboratories, Gordon Memorial College, Khartoum		1908	,, ,,
The Russo-Japanese War. Medical and Sanitary Reports from Officers attached to the Japanese Forces in the Field		1906	,, ,,
Notes on the Prevention of Disease (Headquarters, India)		1907	,, ,,
Routine Work of Station Hospitals of the Burmese Division		1913	,, ,,
British Medical Association. Proceedings of the Clinical and Scientific Meetings, April 8-11		1919	,, ,,

LIST OF BOOKS ADDED TO THE LIBRARY—*Continued.*

Title of Work and Author	Edition	Date	How obtained
Surgical Treatment of War Wounds, Third Army.. ..		1917	Presented by Lieut.-Gen. Sir W. Babtie, V.C., K.C.B., K.C.M.G.
Handbook of Medical Services of Foreign Armies :—			
Part 1. France		1908	,, ,,
Part 2. Germany		1908	,, ,,
Staff Manual War. Provisional		1912	,, ,,
Regulations for Mobilization		1912	,, ,,
War Establishments for Transport and Supply Units of the Expeditionary Force. Provisional		1911	,, ,,
Field Service Manual, Army Medical Service (Expeditionary Force)		1913	,, ,,
Manual of Instruction for Non-Commissioned Officers and Men of the Army Hospital Corps		1875	,, ,,
Manual for the Medical Staff Corps		1894	,, ,,
Standing Orders for the Army Medical Staff		1894	,, ,,
Medical Regulations, 1878, 1885, 1890 and 1896			
Standing Orders for the Expeditionary Force. By Field-Marshal Sir J. D. P. French		1914	,, ,,
Instructions for Disembarkation, Reorganization and Entrainment for Units of Indian Expeditionary Force "A"		1914	,, ,,
A Statistical Inquiry into the Present State of the Medical Charities in Ireland. By Denis Phelan		1835	,, ,,

Royal Army Medical College,
April 12, 1920.

MARRIAGES.

FROST—STIRLING.—On December 31, 1919, at Westminster Cathedral, by the Rev. E. V. Frost (brother of the bridegroom) assisted by the Very Rev. Monsignor Browne, Capt. William A. Frost, O.B.E., Royal Army Medical Corps, youngest son of the late Dr. Edmond Frost, J.P., and of Mrs. Frost, Beech Lawn, Newmarket-on-Fergus, Co. Clare, Ireland, and Josephine, youngest daughter of the late Col. John Stirling Stirling, R.A., and Mrs. Stirling, of Gargunnock, Stirlingshire, Scotland.

MARSHALL—CREE.—On March 22, 1920, at All Saints' Garrison Church, Lucknow, India, by the Rev. Canon R. Irwin, D.S.O., M.C., John Stuart Marshall, D.S.O., Major 35th Sikhs, General Staff, Presidency Brigade, Calcutta, son of J. J. Marshall, Esq., J.P., of Yelverton, Devon, and Alice Deborah, only daughter of Major-Gen. G. Cree, C.B., C.M.G., and Mrs. Cree.

DEATH.

SHERREN—At Constantinople February 28, 1920, Major Hugh Godwin Sherren, Royal Army Medical Corps, aged 37.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

Major just home from India, tour expired, is willing to exchange (to go abroad) with an officer who wishes to remain at home. State terms offered. Apply D.T.M., c/o "Journal of the R.A.M.C.," 8, Serle Street, London, W.C. 2.

Major arrived Egypt December, 1919, for tour, would exchange to go India now or next trooping season. Consideration required. Apply A.C.E., c/o "Journal of the R.A.M.C.," 8, Serle Street, London, W.C. 2.

FOR SALE.—R.A.M.C. Officer's full kit (scarcely worn), includes military frock coat, mess kit, parade uniform, helmet, &c. Uniform and helmet cases. Height 5ft. 10-11ins., chest 36ins. May be seen at T. W. CASTLE, 27, Savile Row, Regent Street, W. 1.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

Number of Reprints	Number of Pages	Cost of Reprints	Cost of Excerpts*	Extra for Covers for Reprints: As Journal, Printed on Front	As Journal, Plain, Unprinted	Cheaper Paper, Printed on Front	Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
	4	0 5 6	0 2 6				
12	8	0 10 0	0 5 0	8 6	2 3	7 0	1 6
	16	0 16 6	0 8 6				
	4	0 6 9	0 3 0				
25	8	0 12 0	0 5 9	9 9	3 0	8 9	2 0
	16	1 1 0	0 10 6				
	4	0 9 0	0 4 0				
50	8	0 15 0	0 7 0	12 0	4 3	10 0	2 6
	16	1 6 6	0 12 6				
	4	0 12 0	0 6 3				
100	8	1 0 0	0 10 0	16 0	8 0	14 0	5 0
	16	1 17 0	0 15 6				
	4	0 19 0	0 9 0				
200	8	1 10 0	0 14 0	1 2 0	15 0	18 0	10 0
	16	2 12 0	0 18 0				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

Cases for Binding Volumes.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 3s. 9d. net; binding, 3s. 9d.
These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

All Applications for Advertisements to be made to—

G. STREET & CO., Ltd., 8, Serle Street, London, W.C.

The back outside cover is not available for advertisements.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are

inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 56, Cornwall House, Stamford Street, S.E. 1.

Communications have been received from the following: Major-Gen. Sir M. W. Russell; Col. A. B. Soltau, C.M.G., C.B.E.; Lieut.-Cols. P. S. Lelean, J. L. Wood.

The following publications have been received:—

British: The Medical Press, The Medical Journal of Australia, The St. Thomas's Hospital Gazette, Proceedings of the Royal Society of Medicine, The Journal of Tropical Medicine and Hygiene, Annals of Tropical Medicine and Parasitology, The Hospital, The Royal Engineers' Journal, The Cavalry Journal, Guy's Hospital Gazette, Edinburgh Medical Journal, The Practitioner, Public Health, Tropical Diseases Bulletin, St. Bartholomew's Hospital Journal, The Indian Journal of Medical Research, The Royal Army Service Corps Quarterly, The Indian Medical Gazette, Medical Research Committee, Agricultural Research Institute, Pusa, The Journal of State Medicine, The Medical Journal of South Africa, Tropical Veterinary Bulletin, Journal of the Royal Naval Medical Service.

Foreign: The Journal of Infectious Diseases, Bulletin de l'Institut Pasteur, Surgery, Gynæcology and Obstetrics, Le Bulletin Médical, Norsk Tidsskrift für Militaermedicin, Archives de l'Institut Pasteur de Tunis, A Prophylaxia Rural no Estado do Paraná, Medicina Militar, L'Ospedale Maggiore, United States Public Health Service, The Military Surgeon, Abstracts of Bacteriology, Bulletin de la Société de Pathologie Exotique, Archives de Médecine et Pharmacie Navales, Bulletin of the Johns Hopkins Hospital, Bollettino dell' Istituto Sieroterapico Milanese, Le Caducée, Colonies et Marine.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," Cornwall House, Stamford Street, S.E. 1, and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,
"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"
CORNWALL HOUSE, STAMFORD STREET, S.E.1.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

JUNE, 1920.

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
May 7, 1920.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign:—

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATION CONFERRED BY HIS MAJESTY THE KING OF ITALY.

Order of the Crown of Italy, Cavalier.

Brevet Major Arthur D. Griffith, M.B., F.R.C.S., Royal Army Medical Corps (Territorial Force).

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF SERBIA.

Order of St. Sava.

1st Class.—Col. Sir Almroth Edward Wright, Kt., K.B.E., C.B., M.D., F.R.C.S.I., F.R.S., late Army Medical Service.

4th Class.—Major Cuthbert Lindsay Dunn, Indian Medical Service; Surg.-Lieut.-Col. Basil Pares, C.M.G., D.S.O., Royal Horse Guards.

5th Class.—Temp. Capt. Edward William Archer, M.B., Royal Army Medical Corps; Temp. Capt. George Herbert Brown, M.D., Royal Army Medical Corps; Temp. Capt. Gerald Spencer Coghlan, M.B.E., South African Medical Corps; The late Temp. Capt. Arthur Maxwell Fisher, M.D., Royal Army Medical Corps; Temp. Capt. John William Grice, Royal Army Medical Corps; Temp. Capt. Ernest Eugene Herga, M.C., Royal Army Medical Corps; Temp. Capt. Orme Stirling Kellett, Royal Army Medical Corps; Temp. Capt. Frank Harold Loonsy, M.B., Royal Army Medical Corps; Temp. Capt. Edward Holmes Rainey, F.R.C.S., Royal Army Medical Corps; Capt. Gilbert Wolridge Ross, M.B., Royal Army Medical Coops (Special Reserve); Capt. (Acting Major) Robert Patrick Starkie, Royal Army Medical Corps (Special Reserve); Temp. Capt. William Johnston Symes, M.B., Royal Army Medical Corps.

Samaritan Cross.

16474 Acting Serjt.-Major W. Lowery, Royal Army Medical Corps (Leeds).

45359 Staff-Serjt. (now Commissioned) W. Milburn, Royal Army Medical Corps (Beckhaven, Fife).

52917 Serjt. F. Taylor, Royal Army Medical Corps (Derby).

59302 Acting Serjt. J. Tomlinson, Royal Army Medical Corps (Streatham Hill, S.W.).

War Office,
May 18, 1920.

The names of the undermentioned have been brought to the notice of the Secretary of State for War for valuable services rendered in connexion with the military operations on the North-West Frontier of India, in East Persia and South Persia, during the period April 1, 1917, to May 31, 1918. To be dated January 1, 1919.

NORTH-WEST FRONTIER OF INDIA.

Commands and Staff.

Col. W. E. Hardy, Indian Medical Service.
Lieut.-Col. R. J. W. Mawhinny, C.B., Royal Army Medical Corps.
Col. A. E. Tate, Army Medical Service.

War Office,
May 20, 1920.

The following dispatch has been received by the Secretary of State for War from General Sir G. F. Milne, G.C.M.G., K.C.B., D.S.O., Commanding-in-Chief, British Army of the Black Sea:—

"General Headquarters,
"Constantinople,
"*February* 11, 1920.

"SIR,—I have the honour to forward herewith, on the occasion of the evacuation of the Caucasus, a list of Officers, Ladies, Warrant Officers, Non-commissioned Officers and Men of the Force under my command, who have been brought to my notice for their continuous. distinguished and devoted services rendered.

"I have the honour to be, Sir,
"Your obedient servant,
"G. F. MILNE, *General*,
"*Commanding-in-Chief, British Army of the Black Sea.*"

ARMY MEDICAL SERVICE.

Temp. Col. A. G. Phear.

ROYAL ARMY MEDICAL CORPS.

Temp. Capt. G. G. Bruce, M.B.
Temp. Capt. (Acting Major) A. Dick, M.B.
Temp. Capt. J. Elder, M.B.
Temp. Capt. (Acting Major) J. D. Gunn, M.D., F.R.C.S.
Temp. Capt. G. B. Wild.
61784 Pte. (Acting Cpl.) A. G. Andrews, 81st Field Ambulance.
528119 Cpl. (Acting Serjt.) C. W. Clark, 1st London Sanitary Company (Territorial Force).
493733 Pte. (Acting Serjt.) G. A. Gobey, 1st H.C. Field Ambulance (Territorial Force).
354531 Pte. F. L. Miller, 3rd East Lancs Field Ambulance (Territorial Force).
510265 Serjt. J. H. Mitcheil, 84th London Field Ambulance (Territorial Force).
103366 Pte. (Acting Cpl.) E. Musselbrook.
63085 Serjt. J. E. Raw.

ROYAL ARMY MEDICAL CORPS (SPECIAL RESERVE).

Capt. R. Chevassut, M.B.
Capt. F. B. Jago.
Capt. G. E. Tilsley.
Capt. W. A. Weatherhead.

War Office,
May 21, 1920.

The name of the undermentioned has been brought to the notice of the Secretary of State for War for valuable services for in connexion with military operations in Kurdistan and Persia. Dated January 17, 1920:—

ROYAL ARMY MEDICAL CORPS.

Capt. (Acting Major) J. M. Weddell.

War Office,
May 26, 1920.

His Majesty the King has been graciously pleased to approve of the award of the Meritorious Service Medal to the undermentioned Non-commissioned Officer in recognition of valuable services rendered with the Baluchistan Force, North-West Frontier, India:—

ROYAL ARMY MEDICAL CORPS.

90489 Qmr.-Serjt. H. A. B. Greenwood (Luton).

ARMY MEDICAL SERVICE.

Col. John D. Ferguson, C.M.G., D.S.O., is placed on half-pay list.

ROYAL ARMY MEDICAL CORPS.

The undermentioned Lieutenant-Colonels and Brevet Colonels relinquish the acting rank of Colonel:—

Dated May 4, 1920.—John C. Connor, C.M.G., M.B.; James A. Hartigan, C.M.G., D.S.O., M.B.

The undermentioned Majors relinquish the acting rank of Lieutenant-Colonel :—
Dated February 8, 1919.—Major Hugh H. J. Fawcett, D.S.O.
Dated February 17, 1919.—Brevet Lieut.-Col. Thomas S. Coates, O.B.E., M.B.
Dated May 1, 1919.—Major Phillip C. T. Davy, C.M.G.
Dated May 7, 1919.—Norman E. Dunkerton, D.S.O.
Dated February 3, 1920.—Brevet Lieut.-Col. Herbert V. Bagshawe, C.B.E., D.S.O.
The undermentioned Lieutenants (Temporary Captains) to be Captains :—
Dated April 2, 1920.—Gerald H. Barry, M.B.
Dated April 9, 1920.—Mortimer McG. Russell, M B.
Dated April 28, 1920.—Frederick G. L. Dawson.
Dated May 1, 1920.—William M. Cameron, M.B.
Dated May 2, 1920.—Arnold G. Harsant.
Dated May 8, 1920.—Melville St. C. Hamilton, Arthur Rodd.
The undermentioned Captains resign their commissions :—
Dated May 20, 1920.—Harold J. Bower, George Jackson, M.C., M.B.
The undermentioned Captains relinquish the acting rank of Major :—
Dated March 23, 1919.—Hugh G. Trayer, M.B.
Dated April 1, 1919.—Captain Thomas J. Hallinan, M.B.
Dated January 3, 1920.—Brevet Major Albert T. J. McCreery, M.C., M.B.
Dated April 4, 1920.—Stanley Fenwick, M.C., M.B.
Dated May 7, 1920.—Charles D. K. Seaver.
The undermentioned Captains to be Acting Majors :—
Dated January 4, 1918.—Edward A. Strachan, M.B. (Substituted for the notification in the *Gazette* of January 30, 1919.)
Dated February 25 to December 15, 1918, inclusive.—John S. McComb, D.S.O., M.B.
Dated January 22, 1920.—Peter J. Ryan, M.C., M.B.
Dated February 10 to April 22, 1920.—William H. O'Riordan, M.C.

Major Charles P. Thomson, D.S.O., M.D., retires, receiving a gratuity, dated January 1, 1918. Substituted for the notification in the *Gazette* of January 7, 1919.

Temp. Capt. William Gemmill, M.B., relinquishes the acting rank of Major, dated December 17, 1919.

Major and Brevet Lieut.-Col. Francis J. Brown, Reserve of Officers, relinquishes the temporary rank of Lieuteuant-Colonel, dated May 2, 1917.

Capt. Arthur S. Cane, D.S.O., O.B.E., M.D., to be temp. Major whilst specially employed, dated April 24, 1920.

Capt. John J. Molyneux, M.B., is placed on the half-pay list on account of ill-health, dated May 13, 1920.

Lieut.-Col. Francis S. Walker, C.B.E., F.R.C.S.I., retires on retired pay, dated May 15, 1920.

Major Thomas D. Harty, D.S.O., to be Acting Lieutenant-Colonel, dated April 17, 1920.

Captain Thomas J. Hallinan, M.B., is seconded for service under the Civil Administration of Mesopotamia, dated April 1, 1920. (Substituted for the notification in the *Gazette* of July 1, 1919.)

Major Ernest V. Aylen, D.S.O., relinquishes the temporary rank of Lieutenant-Colonel, dated March 3, 1919.

Major George A. D. Harvey, C.M.G., to be a Temporary Deputy Assistant Director-General, vice Major A. B. Smallman, D.S.O., M.D., dated February 5, 1919. (Substituted for the notification in the *Gazette* of March 17, 1919.)

NOTES FROM ALDERSHOT.—Major G. E. Cathcart writes :—

Royal Army Medical Corps Football Team.

Season, 1919-20.

The most successful season in the annals of the Royal Army Medical Corps Football Team was concluded on Wednesday, May 3, 1920, when by defeating the Royal Engineers, the Corps team gained the Aldershot Charity Cup. It is certain that all members of the Corps in various parts of our Empire will be interested to know of the team's record.

At the commencement of the season the Corps was in an unsettled state—large numbers of N.C.O.s and men were being demobilized, drafts were proceeding regularly for service abroad and recruits were enlisting daily. It was therefore no easy task to form a football team from absolutely unknown quantities. A Company League was at once formed, and it was from these matches that likely players were discovered. Every N.C.O. and man in the Depot, if he had had any experience at all of football, was given a trial in the Company team.

The competition matches in Aldershot Command did not commence until very late in the season, and it will be seen from the results appended that only two such matches were played before Christmas. No time was lost, however, as a large number of friendly matches were

arranged, and in these every Royal Army Medical Corps man in the Command, who showed any promise in Company football, was given a trial.

This procedure was followed until practically January 17, 1920, when the Corps team was defeated at Cowes in the Hants Senior Cup by 3—1. After this match the team was reorganized, and from that date never looked back. It scored success after success between that date and the end of the season, losing only one match. This was against East Cowes Victoria at Cowes in the semi-final of the Russell-Cootes Charity Cup on May 1. Owing to the congestion of fixtures, four matches had to be played in six days, and it was therefore decided to send a weak team to Cowes —five regimental players and six reserves. It will therefore be seen that the record for the second half of the season was a very fine one.

The regimental team was as follows; Qmr.-Serjt. Quelch; Pte. Osborne; Cpl. Plunkett; Pte. Howarth; Serjt. Sims; Staff-Serjt. Miller Pte. Humphries; Serjt.-Major Prince; Pte. Davies; Pte. Crowther; Pte. Coome.

Of the above team there are only three pre-war players—Qmr.-Serjt. Quelch (goalkeeper), Staff-Serjt. Miller (left half), and Temp. Serjt.-Major Prince (inside right). The remainder are all new to senior football.

Staff-Serjt. Miller, the oldest player in the team, was very unfortunate in getting injured in the fifth round of the Army Cup, and although he resumed playing in the semi-final *versus* the Seaforth Highlanders at Glasgow, he broke down again, with the result that his greatest wish was not realized, i.e., to represent the Corps in the first Army Cup final.

The final tie was a crowning success for the team, who thus for the first time led the Corps to victory in the Army Cup. April 5, 1920, will long remain in the memory of those officers, N.C.O.s and men who were fortunate enough to witness the match. The part played during the season by Serjt-Major Prince cannot be over-estimated. By the brilliancy of his own play, the excellency of his captainship and the splendid sportsmanship which he has always shown, he set a great example to every member of his team and filled them with that spirit of confidence which is essential to success in a hard and critical game.

Great credit is due to the officials of the Corps Club whose untiring energies have been a great factor in the success of the team.

Major F. R. Laing, Hon. Secretary and Officer in charge football, Serjt.-Major Gregson, Assistant Hon. Secretary, and Staff-Serjt. Baigent, who has acted in the capacity of Trainer, deserve special mention.

Strong support has always been received in all matches. This was evidenced at Glasgow, where over 100 supporters undertook the long journey from Aldershot to Glasgow.

Many of the Corps players have represented the Army during the season with distinct success. These were :—

Serjt.-Major Prince (inside right), Serjt. Sims (centre half), Pte. Osborne (left back), Pte. Crowther (inside left), Cpl. Plunkett (left half).

The following are the results of all the matches, both friendly and competition, which have been played during the present season.

RESULTS OF FOOTBALL MATCHES PLAYED BY ROYAL ARMY MEDICAL CORPS, ALDERSHOT FOOTBALL CLUB. SEASON 1919-20.

Friendly Games.

Date	Opponents	Result	Round
6.9.19	Aldershot F.C.	W. 6—1	..
10.9.19	Army Gymnastic Staff	W. 5—3	..
13.9.19	Basingstoke F.C.	L. 2—1	..
16 9.19	R.F.A. Aldershot	W. 6—0	..
20.9.19	Reading F.C.	L. 4—3	..
24.9.19	R.A.S.C. Training Establishment	D. 2—2	..
8.10.19	R.S. Fusiliers	D. 1—1	..
11.10.19	R.A.F.	W. 3—0	..
15.10.19	19th Hussars	W. 13—0	..
25.10.19	R.S. Fusiliers	L. 3—2	..
29.10.19	2nd Cameron Highlanders	D. 1—1	..
1.11.19	R.A.S.C.	W. 9—0	..
15.11.19	1st Manchesters..	W. 1—0	..
22.11.19	2nd A. and S. Highlanders	L. 2—1	..
29.11.19	Aldershot F.C.	W. 4—0	..
20.12.19	Oxford City F.C.	L. 5—2	..

F.A. Amateur Cup.

3.1.20	Cardiff Corinthians	L. 2—1	1st

Date	Opponents	Result	Round
	Army Cup Competition.		
13.12.19	1st K.R.R.C.	W. 3—1	1st Bye / 2nd
13.1.20	2nd East Surrey Regiment	W. 3—1	3rd
12.2.20	R.A.S.C. M.T. Winchester	W. 8—0	4th
25.2.20	Army Gymnastic Staff..	W. 1—0	5th
13.3.20	4th Dragoon Guards	W. 4—0	6th
23.3.20	Seaforth Highlanders	W. 2—0	Semi-final
5.4.20	1st Hants Regiment	W. 1—0	Final
	Aldershot Command-League.		
24.1.20	1st Manchester Regiment	W. 2—1	..
31.1.20	1st Lancs. Fusiliers	W. 8—1	..
18.2.20	1st Royal Fusiliers	W. 4—1	..
	Command Championship.		
15.3.20	1st East Lancs.	W. 4—0	1st
9.5.20	R.H.A. 5th Brigade	W. 8—2	2nd
17.5.20	2nd Cameron Highlanders	W. 4—0	Semi-final
29.5.20	2nd A. and S. Highlanders	W. 1—0	Final
	Hampshire Senior Cup.		
18.10.19	South Farnborough	W. 11—0	1st / 2nd Bye
17.1.20	Cowes F.C.	L. 3—1	3rd
	Russell Cootes' Benevolent Cup, Hants, F.A.		
28.2.20	Winchester City	W. 3—1	1st
20.3.20	Portsmouth Amateurs	W. 4—2	2nd
1.5.20	East Cowes Victoria	L. 3—0	Semi-final
	Aldershot Senior Cup.		
28.1.20	4th Hussars	W. 2—1	1st Bye / 2nd
31.3.20	13th Hussars	D. 3—3	Semi-final
14.4.20	13th Hussars (re-play)	W. 3—0	,,
29.4.20	Aldershot Town	W. 3—1	Final
	Aldershot Charity Cup.		
21.2.20	Excelsior Club	W. 7—2	1st
24.4.20	Aldershot Town	W. 1—0	Semi-final
3.5.20	Royal Engineers	W. 3—1	Final
	Army Cup Winners v. Navy Cup Winners.		
21.4.20	R.M.L.I.	W. 5—2	..

Competitions Gained.

Army Cup. Army Winners *v.* Navy Winners Cup.
Aldershot Senior Cup. Aldershot Command Shield.
Aldershot Charity Cup.

Played, 44. Won, 32. Lost, 8. Drawn, 4. Goals for, 173; against, 39.

The following extract is taken from the *Aldershot Gazette* of April 25, 1920 :—

"PTE. JOE PAPWORTH, R.A.M.C.

"*Holder of the record number of good conduct badges in the British Army.*

"'Twere worth ten years of peaceful life
To glance at their array!'

"To-day Joe Papworth, Royal Army Medical Corps, after the long service of forty-eight years in the British Army, lays aside his khaki coat and dons the civvies' garb. And a glance at the sleeve of that khaki coat has recalled to memory the above lines. Pte. Papworth, as his sleeve depicts, holds the record number of a round dozen good conduct badges! The writer can hear the exclamation of the sceptic, 'Can't be done!' Nevertheless it has been done, and the long military career of Joe Papworth, whose portrait appears for the last time as a serving

British Tommy, is proof positive of the fact! Born in 1852, he leaves the Army at the age of 68, forty-eight years of which have been spent in the service of his country. Not that he was especially cut out or designed for a soldier's life—not a bit of it. Young Papworth would in all probability have entered a very different path of life had it not been for one incident in his career—it was the blowing of a straw, so to speak, that led to his choice of career. His parents were in no way connected with the services, indeed, so far as the subject of our illustration is concerned, he can recall no member of the Papworth family having served a King. Born under peaceful conditions, in a little village in Cambridgeshire, he went with his parents to London to witness that memorable thanksgiving service at St. Paul's in connexion with the restoration to health of the Prince of Wales. That wonderful martial spectacle, the grandeur of the uniforms of the participating troops, the crash of cannon and the sound of many bands, made a wonderful and a lasting impression on the mind of young Papworth. He merely couldn't go back to hum-drum civil life. A strapping young fellow of 19—the call of the drum was irresistible, so he just 'slipped off,' as he himself puts it, and took the Queen's shilling on March 4, 1872. And the new love, which has long since become an old love, has as firm a hold as ever it had, for Papworth is leaving soldiering to-day with 'a tear in his eye and a lump in his throat,' that at last the 'parting of the ways' has been reached, and that the moment for 'good-byes' is at hand. That he takes the affection and best wishes of everyone with whom he has come in contact is readily acknowledged, and later there will be a more tangible tribute paid to him of the high esteem in which he has been held.

[*Photo, Fred Gould, Aldershot.*]

"FIRST A WELSH FUSILIER.

"When he took the Queen's shilling at Westminster, instead of returning with his parents to Cambridgeshire, Papworth was sent off to the Welsh Fusiliers, and he did one period of soldiering with the 1st Battalion, peaceful enough he avows, for it was at the autumn manœuvres of 1872. Two years later the then Army Hospital Corps were calling for volunteers, and he was one of those who offered his services. He was first stationed at Netley. The new work appealed to him and he soldiered at the great hospital until the May of 1874, when a change of venue was brought about by his being sent out to Mauritius, where for five years he was engaged at duties peculiar to his arm of the service. On his return to England Netley again became his station, but only for a few brief weeks, for Bristol at once claimed him for a twelvemonth. Next, the station, which sooner or later claims all its soldier sons, called him, Aldershot, but hardly had he reached the 'wooden camp' than he was sent overseas. January 1, 1881, witnessed his departure, with

others of his Corps, for the Boer war. He served in that campaign until the last bullet had been spent, and the need for service of the healing corps was no longer necessary. He returned to Aldershot in 1885, and with the exception of a somewhat bad attack of enteric fever he 'had nothing to grouse about.' In Africa he learnt a little of the culinary art and was cook in his officer's mess. Later that knowledge was to stand him in good stead. 'I reached Aldershot,' he told the writer, 'the day before Christmas, and I got leave at once to rejoin my wife, whom I had not seen for five long years, at Bristol. I arrived home to find her out shopping with my mother, but I was in ample time for a Christmas dinner that I shall never forget. It was a real home, sweet home coming to me.'

"And when his Christmas leave expired then back to Aldershot our friend came, and 'I have been here ever since. It was a very different camp then. I was quartered with my wife and family in T Lines, quite close to my present quarters in B Terrace, old wooden huts which you cannot conceive (but the writer could and easily recalled the lines he spoke of with their beautiful double may trees, pink and white alike). The Cambridge Hospital had just been completed, but there was not a stone building about us. I had taken my instruction in cookery, and for a long time I was assistant cook at the officers' mess, but the many long years which have since sped away have found me up till now, or until just recently, the cook of the serjeants' mess.'

"A Dislike for the 'Stripe.'

"'Why haven't I taken a stripe? Well, I never had an inclination that way. I never courted promotion, although, of course, I could have had it. My duties in the cookhouse did not call for stripes, and I have just got along very well without them!' Asked whether he was not proud of his other stripes, Papworth smiled and admitted the fact. 'And,' he added, 'I only know of one other young recruit who had anything like my number. It was old Jack Early, of the Artillery, and I believe he had seven or eight.'

"Asked how many it was possible for a soldier to have received at the end of twenty-one years, Mr. Papworth at once replied, 'five, and I possessed ten at forty-two years' service, and the other two I had added to that number after six more years—forty-eight years altogether.'

"'No, I don't get service pay for them on retirement, but I did get pay for seven of them until after the last war broke out. We receive consideration for these badges in what is called proficiency pay now, so you see they are not going to prove a joy and a blessing for ever afterwards! I don't suppose it will ever happen again that a man will be able to leave the Service with twelve stripes on his arm.'

"Asked as to his family, he was proud to say that his two sons had followed in their old father's footsteps, and had served in the war—'they had a better education than me,' he sighed, 'and should do better. I have four girls, and some are married in the Army.' And here the writer will add, Mrs. Papworth seemed as pleased at the important fact as her better half! He has the Good Conduct and Long Service Medal, and also the King's Coronation Medal, but as he said, 'there was no medal struck for that stiffish bit of work in the first Boer war.' He is enjoying good health and is on the eve of retiring to his native place in Cambridgeshire, there to spend the evening of his life in what we sincerely trust may prove well earned leisure and repose."

NOTES FROM NETLEY.

Summary of Sports, April, 1920, No. 4 Company, R.A.M.C., Netley.

The Officers' Sports Summary this month must begin and end with golf. The non-golfers in the Mess have had a poor time, and many have been obliged to take up the game in self-defence.

The foursome tournament was an unqualified success, and produced a series of games the like of which have never previously been witnessed on the Stoneham Links.

The selection of partners was as follows; the back-marker was partnered by the biggest handicap man and so on down the list.

There was no small amount of speculation as to whether the "outside" pairs or the "middle" pairs would come out best. As things turned out the final was fought out between the two top men and their partners, Major Stephens (plus 1) and Col. Browne (30), just winning from Capt. Keswick (plus 2) and Capt. Elkington (36).

On the result of this competition a new "ladder of fame" has been posted, and it is mooted that another tournament on the same lines is to be held.

Netley's representative in the Army Golf Championship finished sixth in a large Field.

The R.A.M.C. Southern Command was unfortunately unable to collect a team of four officers to compete for the Army Challenge Cup.

Otherwise sporting events have been in abeyance. Next month, however, I hope to have something to say about the Netley "week" (to be held this year at the beginning of July), and also about current cricket.

Preparations for lawn tennis, croquet and sailing are in full swing and before long, at least two officers will own motor boats.

General Notes.—The hospital continues to receive convoys from overseas, and foreign invalids from the East in such numbers as to keep the accommodation fairly well taxed. Difficulties of

finding trained Royal Army Medical Corps staff have been overcome by the employment of civilians "in lieu of." The difficulties of administration under this system in a place like Netley are better imagined than described, but in spite of all, the hospital runs with a good swing and very little room is left for criticism.

Netley has been chosen as the Central Station in the Southern Command for the Corps promotion examinations. Everyone who knows the place will recognize the many advantages it holds for this purpose. Candidates will find themselves in congenial surroundings, and the natural beauties of the environments will make the examination much more of a holiday than an ordeal.

Entertainment.—Netley, in company with the Army at large, has lost a good many men from its staff recently. In addition to those whose "D. of W." period expired on the 30th, several "twenty-oners" left us at the same time. On April 29, an entertainment was held in the Serjeants' Mess to wish "Good Luck" to all members leaving the Station for civil life. The Commanding Officer, Col. G. A. Moore, C.M.G., D.S.O., regretted his inability to attend, owing to family mourning. A most jovial evening was spent, everybody coming forward to make the evening a success. Major F. A. Stephens, D.S.O,, Registrar, in a few well-chosen phrases wished the leaving members all good fortune and health for their civil life. He also greatly added to the merriment of the evening by recounting a few yarns. The commanding officer having kindly granted a generous extension of hours, it is best to leave the next morning out of the account.

The leaving regular members were: Serjt.-Major Horn, Qmr.-Serjt. Storey, Qmr.-Serjt. Evans, Staff-Serjt. Rayner, Staff-Serjt. Ward and Serjt. Powell.

Tennis.—The Serjeants' Mess Tennis Club has been organized again this year and the season opened. The courts are in splendid condition and the members very keen. Some good play has already been seen.

Cricket.—The popularity of Netley for cricket is shown by the fact that the fixture cards of the club, full for every Wednesday and Saturday throughout the season, contains only three "away" matches.

The clerk of the weather caused the first two fixtures of the club to be cancelled.

On Wednesday, the 11th, the club met Mr. F. G. Willoughby's XI. from Eastleigh. Fair weather had prevailed, and the afternoon brightening had produced a fair pitch. The result was a win for Netley by 17 runs.

Netley Garrison Cricket Club.

Mr. Ross, b. Willoughby	2
Qmr.-Serjt. Couchman, b. Harfield	4
Serjt. Southern, b. Willoughby	1
Lieut.-Col. Turner, c. Webb, b. Willoughby	5
Lieut.-Col. Greenwood, c. Webb, b. Andrews	34
Capt. Rowley, b. Webb	46
Qmr.-Serjt. Sullivan, c. Lewry, b. Andrews	0
Staff-Serjt. Kent, b. Harfield	11
Dr. McGrath, b. Webb	0
Serjt.-Major Boxshall, c. Crewe, b. Webb	0
Mr. Richards, not out	0
Byes	4
Total	107

Mr. Willoughby's XI.

A. C. Crewe, b. Sullivan	9
C. Lewry, c. Southern, b. Sullivan	8
E. Harfield, c. and b. Turner	24
S. W. Voss, b. Sullivan	2
A. Webb, l.b.w., b. Sullivan	5
W. H. Lewry, c. Greenwood, b. Turner	19
A. H. Thornton, c. Kent, b. Boxshall	8
D. Andrews, b. Turner	1
F. G. Willoughby, c. and b. Boxshall	3
E. Rice, not out	1
Byes	5
Total	85

NOTES FROM GIBRALTAR.—Serjt.-Major P. T. Simes writes:—

It is now some years since events have been chronicled of the doings of No. 28 Company, Royal Army Medical Corps. The present Company, the majority of whom joined from home in August, 1919, is rapidly settling down to pre-war conditions. Visits to Tangier, Ceuta and other places of interest have been paid by several members of the Company.

Hockey.—Some very interesting hockey games have been played during the past season by the "Staff and Departmental" Team, Major W. G. Wright, D.S.O., Royal Army Medical Corps, being in great form. Other members who played consistently were Staff-Serjt. Cheater, Serjts. Huppler and Warnes, Cpl. Sandys and Pte. Carthy. The team, which won the Governor's Cup last year, reached the final this season against the R.G.A. South.

The football team did not do so well this season, but it is hoped to do better when members become more used to the peculiar conditions prevailing on the "Rock."

The cricket team made a very auspicious start by winning their first game against the "Nomads" on the Garrison Recreation Ground, getting their opponents out for 145 runs and scoring 160 runs for six wickets, Serjts. Huppler and Warnes and Pte. Fowler contributing 116 runs between them. Major S. M. Meadows, D.S.O., Royal Army Medical Corps, captained the team. It is hoped to secure the services of Col. H. S. Thurston, C.B., C.M.G., C.B.E., A.M.S., a very keen cricketer, who has lately taken over the office of D.D.M.S.

Innings of the Nomads.

Staff-Serjt. Davidson, R.E., l.b.w., b. Huppler	33
Serjt. Jackson, R.G.A., b. Major Meadows	14
Lieut. Boyt, R.G.A., c. Fowler, b. Major Meadows	2
Serjt.-Major Taylor, R.G.A., not out	51
Mr. Challoner, c. Fowler, b. Tait	10
Serjt.-Major Parselle, R.A.S.C., b. Tait	0
Serjt.-Major Gillat, R.A.S.C., c. Taylor, b. Tait	8
Lance-Cpl. Argent, R.A.S.C., b. Major Meadows	0
Lance-Cpl. Johnson, R.A.S.C., c. Eaton, b. Major Meadows	18
Serjt.-Major Goodey, R.A.S.C., run out	2
Mr. Laughton, b. Fowler	0
Extras	7
Total	145

Bowling { Major Meadows .. 4 for 33
Pte. Tait .. 3 for 14

Innings of the Royal Army Medical Corps.

Serjt. Huppler, c. Johnson, b. Argent	46
Serjt. Taylor, c. (sub.), b. Davidson	1
Major Meadows, b. Davidson	10
Serjt. Warnes, c. (sub.), b. Jackson	26
Pte. Fowler, run out	44
Pte. Tait, stumped, b. Jackson	1
Major Richard, not out	8
Pte. Garner, not out	5
Lance-Cpl. Waite, Ptes. Eaton and Molloy did not bat	
Extras	9
Total for 6 wickets	150

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

REPORT FOR THE YEAR ENDED FEBRUARY 29, 1920.

The number of subscribers to the Fund during the past year was 746, almost the same as in the previous one. The entrance fees paid were thirty-six as against twenty-two; but twenty-five more have been received since the beginning of the present year. All non-subscribers serving at home have received fresh individual notices. These have been sent to all officers on joining, but in the case of a very large number abroad have no doubt failed to reach them. They are being repeated.

As was expected, the calls on the Fund during the past year have been heavy. It will be seen from the accounts that grants and loans to the amount of £1,410 have been made to six Messes. The total sum thus paid in the last seven years amounts to £2,400. Of this the London Mess has received £1,150 (including a loan of £300), Netley £330, the Depot £300 (including a loan of £150), Aldershot £245, Curragh £125 and Cosham £50. Of the Indian Messes, Peshawar received £100 and Lucknow and Bangalore £50 each. In addition to the above in the present year grants of £100 each to Peshawar and Bangalore have been made, and the Depot Mess has received a further loan of £100.

The question of the Rawal Pindi Mess has been under consideration and a proposal is submitted to the General Meeting. The Central Mess Fund was invited to acquire that Mess, for a sum of not less than Rs. 25,000, which, if otherwise desirable, is far beyond the means of the Fund.

The Messes at the Depot (Crookham Camp) and Tidworth have been added by the Committee to the list of permanent Messes which are entitled to help from the Fund.

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

Cash Statement for the Year ended February 29, 1920.

Dr.

Date	*Income.*	£ s. d.	£ s. d.
1919. Mar. 1.	To Balance of Cash brought forward from 1918-1919		616 0 6
	,, Interest on Investments (after deducting Income Tax at 6s. in the £)		64 0 3
	,, Subscriptions of Members (746)		523 7 6
	,, Entrance Fees (36)		187 16 9
	,, Credit Balance from Temporary Messes on closing—		
	(*a*) 101st Field Ambulance..	1 16 0	
	(*b*) Crowborough	0 14 2	
	(*c*) First Army, Royal Army Medical Corps School of Instruction ..	31 18 6	
			34 8 8
1920. Feb. 29.	To Overdraft at Bank		109 8 2
			£1,535 1 10

Cr.

Date	*Expenditure.*	£ s. d.	£ s. d.
1919 March 1.	By Grants to Messes : London	360 0 0	
	Netley ..	250 0 0	
	Aldershot	125 0 0	
	Cosham	50 0 0	
	Depot ..	150 0 0	
	Curragh	25 0 0	
			960 0 0
	,, Loans to Messes : London	300 0 0	
	Depôt ..	150 0 0	
			450 0 0
	,, Joining Contributions Paid to Messes on behalf of Subscribers : Netley ..	29 18 6	
	Aldershot	46 4 0	
	Peshawar	18 2 0	
			94 4 6
	,, Repayment of Balance held for Royal Army Medical Corps Entertainment Fund, Sierra Leone		14 14 1
	,, Auditor's Fee		3 3 0
	,, Office Expenses : Typing ..	2 11 7	
	Printing	3 2 0	
	Stationery	3 0 11	
	Stamps ..	3 15 3	
	,, Share of Reporter's Fee ..	0 10 6	
			13 0 3
			£1,535 1 10

Balance Sheet at February 29, 1920.

Liabilities.	£ s. d.
Overdraft at Bank	109 8 2
Balance	2,013 9 4
	£2,122 17 6

Assets.	£ s. d.
Investments (valued at middle published prices on February 27, 1920)—	
£1,150 five per cent War Loan 1929-47	1,014 17 6
£700 five per cent National War Bonds, 1928	658 0 0
Loans : London Mess	300 0 0
Depot Mess	150 0 0
	£2,122 17 6

Audited and found correct

May 7, 1920. (Signed) E. J. BUCKLEY, *Major, R.A.M.C.*

(Signed) J. T. CLAPHAM, *Captain, Hon. Secretary.*

The silver placed at the disposal of the Committee by the late Mess at Roberts' Heights, Pretoria, has been divided between the Cosham, Depot and Tidworth Messes. The late Quetta Mess presented its credit balance of £71 10s. to the Fund, its plate being distributed amongst the Indian Messes.

The provisional constitution of the Committee (viz., one member from each Command and permanent Mess at home, and one representative of each permanent Mess abroad) has proved most satisfactory. The attendance at the meetings has been very large, many members making long journeys to be present. The General Meeting is asked to confirm the present constitution.

3, *Homefield Road,* J. T. CLAPHAM, *Captain,*
Wimbledon. S.W. *Hon. Secretary.*

AUXILIARY ROYAL ARMY MEDICAL CORPS FUND.

THE Annual Meeting of this Fund was held at 11, Chandos Street, Cavendish Square, W.1, on April 30, 1920. General Sir John Goodwin, D.G.A.M.S., in the Chair.

Since the last annual meeting £1,974 has been granted to help the maintenance of the orphans of 31 officers in the Auxiliary Royal Army Medical Corps who lost their lives as a result of the war, and £2,620 has been granted in the same way to the orphans of 83 of the rank and file; making a total of £4,594 granted, and 114 cases relieved in a single year. As frequently several children of a single case were relieved, it will be seen that the total number of persons relieved was considerable.

The major part of the income of the Fund is derived from subscriptions, and the Committee earnestly hope that these will continue to be sent to the Hon. Secretary at the above address.

UNITED SERVICES MEDICAL SOCIETY.

A GENERAL meeting of the United Services Medical Society was held at the Royal Army Medical College, on May 28, 1920, when it was resolved to amalgamate with the War Section of the Royal Society of Medicine on the condition that the late members of former Society are accepted without entrance fee to the War Section, but subject to an annual fee of one guinea.

The United Services Medical Society decided to hand over to the Royal Society of Medicine the balance of cash as shown on the books on January 1, 1915, the remainder to be divided amongst the subscribers since that date. It is requested that those subscribers will forward their present addresses to the Secretary to permit of this adjustment.

E. M. MIDDLETON, *Major,*
Secretary United Services Medical Society.

DEATH.

BALFOUR.—At the Station Hospital, Quetta, on March 16, after a short illness, Brevet Major T. H. Balfour, M.C., Royal Army Medical Corps. Deeply regretted by his brother officers.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

OFFERS.—R.A.M.C. Uniforms, height 5 ft. 9 in., chest measurement 40 in., full dress frock coat, patrol, mess, khaki, Indian drill, helmet, pith helmet, uniform cases, tin-lined boxes, kit bag; also a double-barrel breech-loading gun, with cartridges, No. 12; also Infantry Officer's scarlet full dress coat, trousers, and helmet. Height 5 ft. 7 in., chest measurement 39 in. Apply F. G. SHERREN, 31, Grange Road, Ramsgate.

FOR SALE.—Captain's Uniform, full dress, frock coat, patrol, mess kit, home and tropical. Height 5 ft. 7½ in., chest 34 in. Mess Wellingtons, with hollow trees, size 7. Also Morning Suit, good as new. Uniform case thrown in. Apply T. W. CASTLE, 27, Savile Row, Regent Street, W. 1.

Senior Major, well down on home roster, is prepared to negotiate an Exchange to go abroad, preferably for part tour, with officer now on leave from Middle East or India. Apply J. G., c/o "Journal of the R.A.M.C.," 8, Serle Street, London, W.C. 2.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

Number of Reprints	Number of Pages	Cost of Reprints	Cost of EXCERPTS*	Extra for Covers for Reprints			
				As Journal, Printed on Front	As Journal, Plain, Unprinted	Cheaper Paper, Printed on Front	Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
12	4	0 5 6	0 2 6	8 6	2 3	7 0	1 6
	8	0 10 0	0 5 0				
	16	0 16 6	0 8 6				
25	4	0 6 9	0 3 0	9 9	3 0	8 9	2 0
	8	0 12 0	0 5 9				
	16	1 1 0	0 10 6				
50	4	0 9 0	0 4 0	12 0	4 3	10 0	2 6
	8	0 15 0	0 7 0				
	16	1 6 6	0 12 6				
100	4	0 12 0	0 6 3	16 0	8 0	14 0	5 0
	8	1 0 0	0 10 0				
	16	1 17 0	0 15 6				
200	4	0 19 0	0 9 0	1 2 0	15 0	18 0	10 0
	8	1 10 0	0 14 0				
	16	2 12 0	0 18 0				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

CASES FOR BINDING VOLUMES.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 3s. 9d. net; binding, 3s. 9d.
These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 56, Cornwall House, Stamford Street, S.E. 1.

Communications have been received from the following: Col. Sir R. H. Firth, Col. C. E. Pollock; Capt. J. W. Edington; C. C. Douglas, Esq., A. Romanes, G. G. Johnstone; Capt. A. Davies.

The following publications have been received:—

British: The Medical Press, Veterinary Review, Guy's Hospital Gazette, The Journal of Tropical Medicine and Hygiene, The Medical Review, Proceedings of the Royal Society of Medicine, Journal of the United Service Institution of India, The Journal of the Royal Army Service Corps, The Hospital, St. Bartholomew's Hospital Journal, Tropical Diseases Bulletin, The Indian Medical Journal, Edinburgh Medical Journal, Transactions of the Society of Tropical Medicine and Hygiene, The Medical Journal of South Africa, The St. Thomas's Hospital Gazette, The Practitioner, The Journal of State Medicine, Bulletin of Entomological Research, Public Health, The Medical Journal of Australia.

Foreign: Archives de Médecine et de Pharmacie Militaire, The Journal of Infectious Diseases, The Military Surgeon, Surgery, Gynæcology and Obstetrics, Le Bulletin Médical, Bulletin of the Johns Hopkins Hospital, Giornale di Medicina Militare, Abstracts of Bacteriology, Medicina Militar, Le Caducée, Zeitschrift für Militärärzte, Annali di Medicina Navale e Coloniale, Archives Medicale Belges, Archiv für Schiffs-und Tropen-Hygiene, The American Journal of Syphilis, Archives de Medicine et Pharmacie Navales, Memorias de Instituto Oswaldo Cruz, L'Ospedale Maggiore, Colonies et Marine, Office Iniernational D'Hygiene Public.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," Cornwall House, Stamford Street, S.E. 1, and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,
"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"
CORNWALL HOUSE, STAMFORD STREET, S.E.1

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